opt. med.

Vol. 19, No. 5 MAY, 1942

LIBRARY
MAY 26 1942
DARTMOUTH COLLEGE

AMERICAN JOURNAL OF OPTOMETRY *and* ARCHIVES *of* AMERICAN ACADEMY OF OPTOMETRY

EDITORIAL COUNCIL

R. J. BEITEL, JR.
HOWARD C. DOANE
GLENN A. FRY
A. P. WHEELOCK
J. FRED ANDREAE
G. O. OHLSSON
D. R. PAINE
E. LEROY RYER

ASSOCIATE EDITORIAL REFEREES

R. E. BANNON
BRANT CLARK
M. THOMA EBERL
WM. FEINBLOOM
RICHARD M. HALL
E. E. HOTALING
D. G. HUMMEL
O. J. MELVIN
FRANK K. MOSS
J. NEUMUELLER
E. PETRY
CHARLES SHEARD

EDITORS

CAREL C. KOCH

GUY L. DUPLESSIS
CLARENCE W. MORRIS

COLLABORATORS

A. N. ABBOTT, *Shawano, Wis.*
E. ALLGAIER, *Washington, D. C.*
F. L. AVERA, *Los Angeles, Calif.*
J. O. BAXTER, JR., *New Bern, N. C.*
J. O. BAXTER, SR., *New Bern, N. C.*
R. C. BAXTER, JR., *Warren, Ohio*
R. T. BEST, *Fairmont, Minn.*
F. W. BROCK, *Staten Island, N.Y.C.*
W. I. BROWN, *New Bedford, Mass.*
J. ROBINSON COHEN, *New York, N.Y.*
J. H. DRAKEFORD, *New York, N. Y.*
ISRAEL DVORINE, *Baltimore. Md.*
T. H. EAMES, *Arlington Center, Mass.*
R. H. EHRENBERG, *Granite Falls, Minn.*
V. ELLERBROCK, *Columbus, Ohio*
T. A. W. ELMGREN, *Columbia, S. C.*
A. B. EMMES, *International Falls, Minn.*
WARD H. EWALT, JR., *Pittsburgh, Pa.*
W. S. FARMER, *Oklahoma City, Okla.*
H. M. FISHER, *New York, N. Y.*
L. P. FOLSOM, *South Royalton, Vt.*
H. L. FOUG, *Los Angeles, Calif.*
H. K. FULKERSON, *Somerset, Ky.*
M. FURMAN, *New York, N. Y.*
W. GASSON, *Watford Herts, Eng.*
W. H. GLAZER, *Philadelphia, Pa.*
J. G. GOODSELL, *Los Angeles, Calif.*
P. B. GOSS, *Philadelphia, Pa.*
N. GREEMAN, *San Antonio, Texas*
R. GREENSPOON, *Beverly Hills, Calif.*
W. GREENSPOON, *Bluefield, W. Va.*
H. GRUMAN, *Lebanon, Pa.*
HOWARD F. HAINES, *Columbus, Ohio*
W. J. HEATHER, *Southbridge, Mass.*
E. A. HUTCHINSON, *Los Angeles, Cal.*
O. H. JOHNSON, *Jonesboro, Ark.*
J. CLAIRE KEHOE, *Flint, Mich.*
L. H. KRASKIN, *Washington, D. C.*
E. W. LARSON, *Hibbing, Minn.*
A. R. LAUER, *Ames, Iowa*
C. J. LOOSER, *Lodi, Calif.*
M. LUCKIESH, *Cleveland, Ohio*
G. A. MACELREE, JR., *Philadelphia, Pa.*
A. H. MALIN, *Philadelphia, Pa.*
H. B. MARTON, *Manchester, Eng.*
D. J. MAYER, *Riverside, Calif.*
W. A. MEYER, *Sacramento, Calif.*
LEO J. MILLER, *Lincoln, Nebr.*
H. MOLISH, *Columbus, Ohio*
RAY MORSE-PECKHAM, *Detroit, Mich.*
H. G. MOTE, *Columbus, Ohio*
JOHN C. NEILL, *Philadelphia, Pa.*
C. R. PADELFORD, *Fall River, Mass.*
G. A. PARKINS, *Ord, Nebr.*
J. I. PASCAL, *New York, N. Y.*
HARRY E. PINE, *Chicago, Ill.*
H. S. PLAYER, *Stockton, Calif.*
E. E. REESE, *Westerville, Ohio*
A. R. REINKE, *Oakland, Calif.*
EARL R. RIDGEWAY, *Trenton, N. J.*
S. H. ROBINSON, *Prescott, Ariz.*
CHARLES I. SAKS, *Syracuse, N. Y.*
S. H. SHURIN, *Kansas City, Mo.*
R. SIMPSON, *Pasadena, Calif.*
S. W. SMITH, *Philadelphia, Pa.*
WILLIAM SMITH, *Boston, Mass.*
M. STEINFELD, *Paducah, Ky.*
K. B. STODDARD, *Berkeley, Calif.*
W. J. TAIT, *Philadelphia, Pa.*
S. A. TITUS, *Kansas City, Mo.*
R. N. WALKER, *Winston-Salem, N. C.*
NEILL WARREN, *Los Angeles, Calif.*
E. G. WISEMAN, *Buffalo, N. Y.*
ARENE T. WRAY, *Los Angeles, Calif.*
NORMAN Z. ZEVIN, *Lehighton, Pa.*

Published Monthly by the AMERICAN JOURNAL OF OPTOMETRY PUBLISHING ASSOCIATION,
1501 Foshay Tower, 821 Marquette Ave., Minneapolis, Minn.

ANNUAL SUBSCRIPTION $4.00 CANADA $4.50, FOREIGN $5.00
Single copies, 50c

Entered as second-class matter February 20, 1924, at the postoffice at Minneapolis, Minnesota.
under the Act of March 3, 1879.

such popularity etc. - etc.!

This is a little Winger bird (just a fledgling some two months young) but thousands have adopted him already.

He's growing fast, too, because only a Winger delivers so much all-round satisfaction. The profession likes the Winger for its larger lens area, and lack of rim interference—visibility unlimited. The wearer is intrigued with the Winger's flattering design—always in good taste and never flamboyant.

Visit the Konoptic booth in coming conventions and become acquainted with the Winger. He will be a big-big bird then and just about the hit of the show.

KONOPTIC
WINGERS

Please order thru your jobber

Wingers No. 1
(*Low Ful-vue*)
English hinges and shields with skullfit paddle temples.

Wingers No. 2
Illustrated
(*Low Ful-vue*)
Inlaid hinges and shields with Jr. Hollywood temples.

KONO MFG. CO. Woodside, N. Y.

AMERICAN ACADEMY OF OPTOMETRY

Dr. Arthur P. Wheelock, *President*
Des Moines, Iowa

Dr. Curtis R. Wells, *Vice-President*
Boston, Mass.

Dr. J. Fred Andreae, *Secretary*
Baltimore, Md.

EXECUTIVE COUNCIL

Dr. Arthur P. Wheelock, *Chairman*
Des Moines, Iowa

Dr. Curtis R. Wells, *Vice-Chairman*
Boston, Mass.

Dr. J. Fred Andreae, *Secretary*
Baltimore, Md.

Dr. W. Edward Dewey
Battle Creek, Mich.

Dr. Wm. Greenspoon
Bluefield, W. Va.

Dr. Harold Fisher
New York, N. Y.

Dr. Glenn Winslow
Los Angeles, Calif.

Office: American Academy of Optometry: 901-903 Lexington Bldg., Baltimore, Md.

The AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF THE AMERICAN ACADEMY OF OPTOMETRY serves as the official publication of the American Academy of Optometry. It is published monthly by the American Journal of Optometry Publishing Association under the editorial supervision of the American Academy of Optometry.

Publication Office: 1501-1504 Foshay Tower, 821 Marquette Ave., Minneapolis, Minn.

AMERICAN JOURNAL OF OPTOMETRY
and ARCHIVES *of*
AMERICAN ACADEMY OF OPTOMETRY

Vol. 19 — No. 5

CONTENTS

Page

ORIGINAL PAPERS

A Phoroptor Technique for Presbyopia. E. LeRoy Ryer and Elmer E. Hotaling 191

Histologic Observations of the Angle of the Anterior Chamber in Glaucoma. John E. Asarkoff 195

A Stereoscopic Method of Measuring Hyper-Cyclophoria. S. Herman Shurin 205

Additional Stereoscopic Check Tests to Accompany the Stereoscopic Method of Measuring Hyper-Cyclophoria. S. Herman Shurin 212

A Telescopic Method of Ophthalmoscopy. Mathew B. Alpern 214

EDITORIALS

An Ophthalmoscopic Routine. Clarence W. Morris 221

TRANSACTIONS OF THE ACADEMY by J. Fred Andreae 226

BOOK NOTICES AND REVIEWS 226

ABSTRACTS 231

CURRENT COMMENTS by Carel C. Koch 236

When the Security of America is at Stake, "*Optical Quality*" has real significance

If, indeed, it is a war of materials, America is surely in the hands of its workers. They are no more capable than their eyesight. Through your training and experience, you are equipped to prescribe a correction for any eyes to give the best vision of which they are capable. Bausch & Lomb offers optical products built to precision limits that assure the maximum benefit from your professional skill. Now is the best time to standardize on Bausch & Lomb Orthogon,* Panoptik,* Loxit (the B&L molded rivet mounting).

**In Soft-Lite, too*

Bausch & Lomb

OPTICAL COMPANY • ESTABLISHED 1853

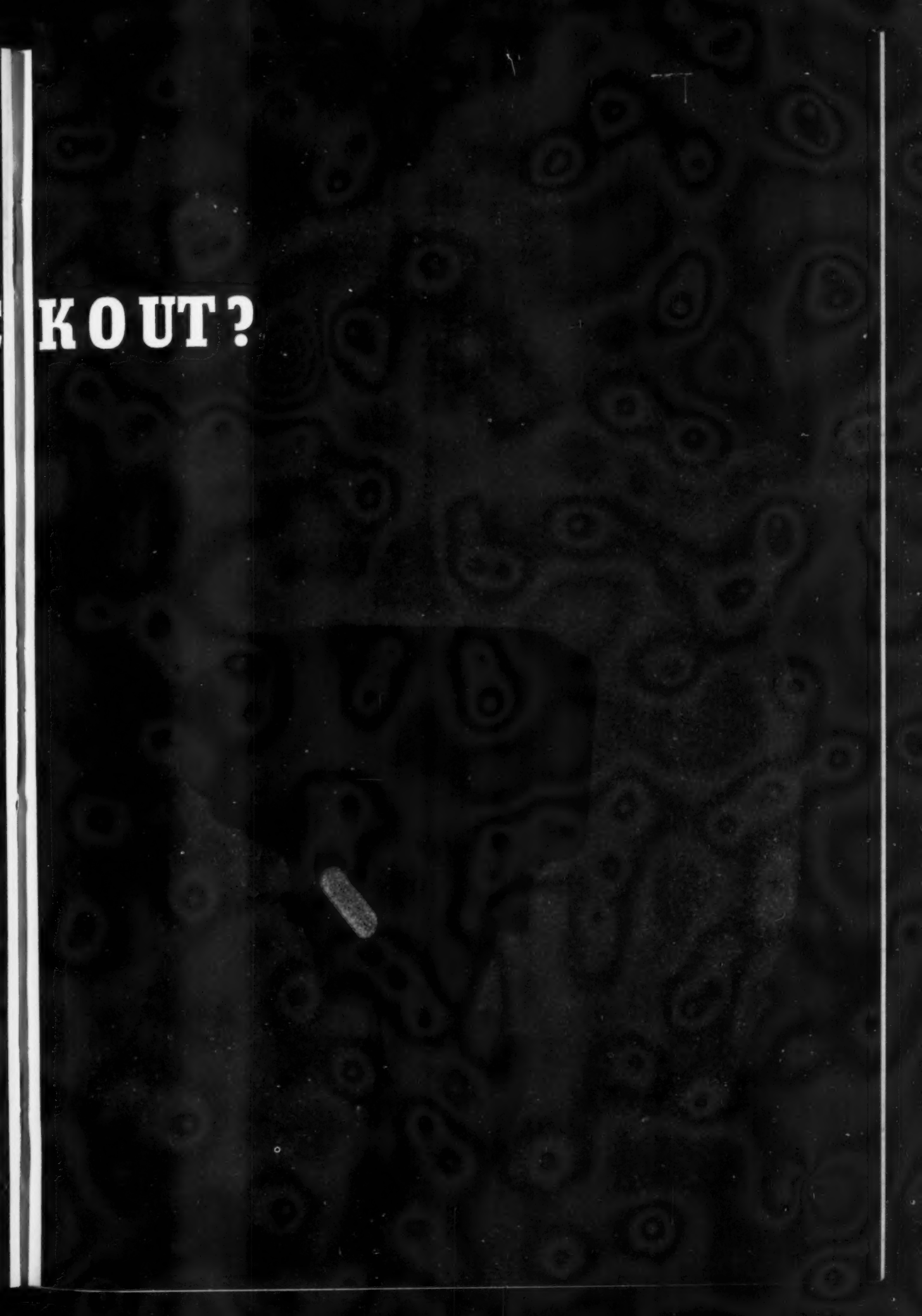
How well do your patients see in a BLAC

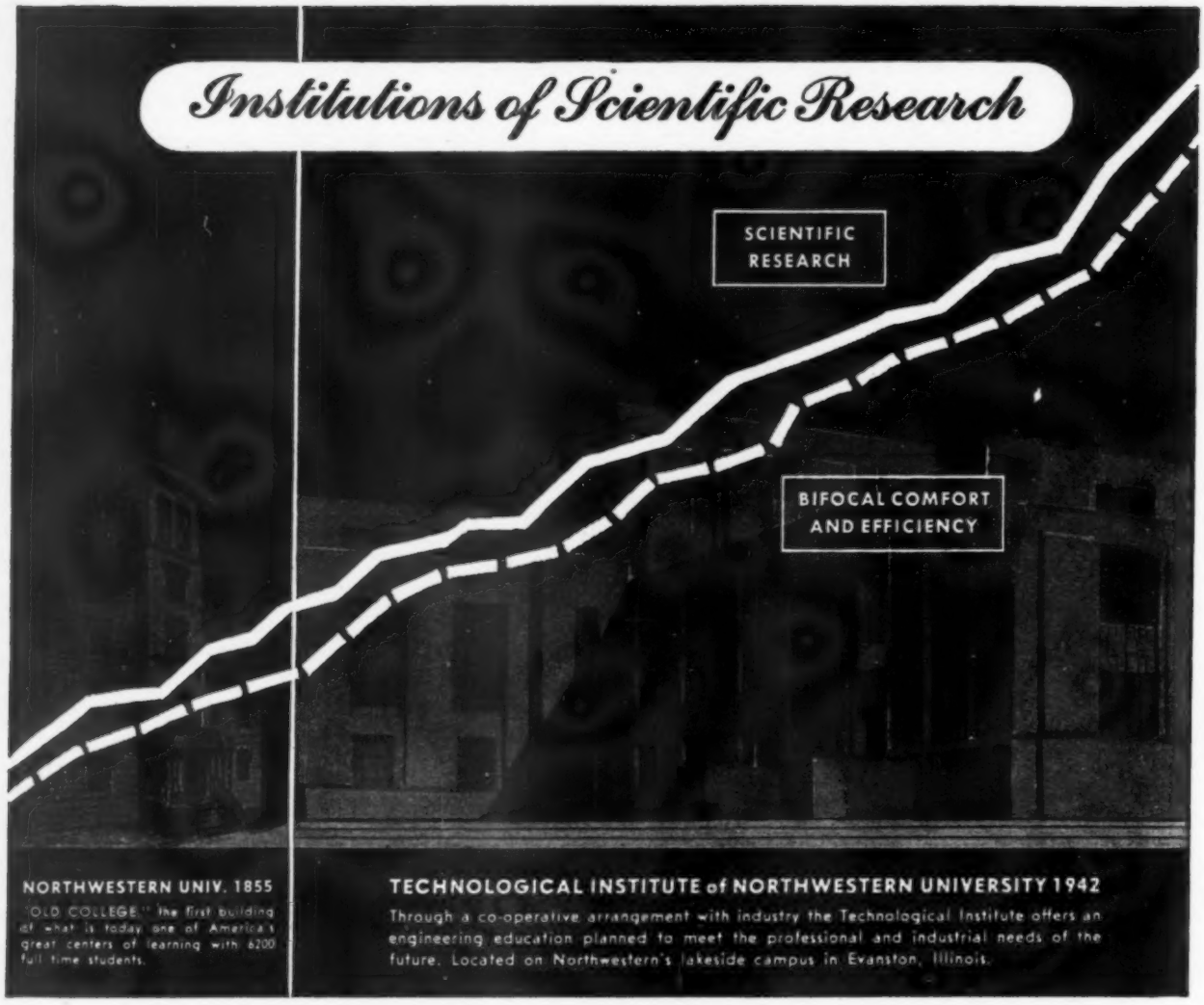
The stygian darkness of a blackout drives home the need of checks for night blindness. One has only to stumble about in a suddenly darkened city to realize that fact. The value of the Feldman Adaptometer as a qualitative instrument for detecting night blindness is becoming more and more obvious. The Feldman Adaptometer offers you a timely opportunity to add to your diagnoses. It will add to the satisfaction of your patients, who now, more than ever before, depend on your professional knowledge, skill, and training for the vision so vital to victory.

BUY U.S. WAR BONDS

THE American Optical COMPANY

KOUT?




Institutions of Scientific Research
SCIENTIFIC RESEARCH
BIFOCAL COMFORT AND EFFICIENCY
NORTHWESTERN UNIV. 1855
"OLD COLLEGE" the first building of what is today one of America's great centers of learning with 6200 full time students.
TECHNOLOGICAL INSTITUTE of NORTHWESTERN UNIVERSITY 1942
Through a co-operative arrangement with industry the Technological Institute offers an engineering education planned to meet the professional and industrial needs of the future. Located on Northwestern's lakeside campus in Evanston, Illinois.

TODAY'S VISUAL TASKS BECOME EASIER

With Bifocals that Follow the Upward Trend of Scientific Research

Orthogon and Panoptik bifocals, in White and Soft-Lite, have kept pace with, in fact are children of, scientific research. Prescribe them and you can rest assured that your patients will be prepared for today's visual tasks.

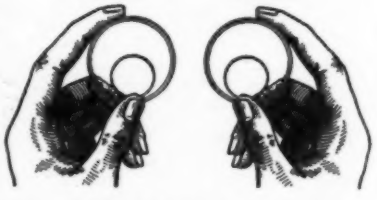
Back of Riggs Prescription Service stands the Bausch & Lomb Scientific Bureau, a staff of specialists who search constantly for the "new," the "better." They are not content to rest on the laurels of Orthogon, Panoptik, Barium Crown Glass, Ray-Ban, and Loxit.

It is their duty to keep Bausch & Lomb products abreast of scientific research. It is our duty to accurately fill your prescriptions . . . using only the products which scientific research has proved efficient and comfortable.

RIGGS OPTICAL COMPANY

Distributors of Bausch & Lomb Products

General Offices: Chicago, San Francisco; Branches in Principal Western and Mid-Western Cities



THEY LOOK ALIKE . . .

But their optical performance and quality are entirely different.

Prescribe Orthogon D for three patients and allow their enthusiasm to demonstrate that Orthogon D is a firm foundation upon which to build your practice

AMERICAN JOURNAL OF OPTOMETRY
and ARCHIVES *of*
AMERICAN ACADEMY OF OPTOMETRY

Vol. 19 MAY, 1942 No. 5

A PHOROPTOR TECHNIQUE FOR PRESBYOPIA*

E. LeRoy Ryer, Opt.D., F.A.A.O.
and
Elmer E. Hotaling, Opt.D., F.A.A.O.
New York, N. Y.

The paper deals specifically with the physically, physiologically, psychologically, and chronologically normal presbyope, and with a technique designed to meet his visual demands.

It has been learned that the Phoroptor affords a more effective means than the trial case for applying this technique.

A direct outline of the technique will be given first, not empirically, certainly not dogmatically, but in the belief that this in itself will enable many readers to decide without further consideration whether this technique is of any practical value to them. For those who may wish to consider its *raison d'etre,* that will follow.

The Example:

Presbyope. Age 50. Statically emmetropic and orthotropic. Working and reading distance (preferred, or imposed by the nature of his work) 16 inches. Character of near work, nothing out of the ordinary. The "simple" case lying in wait for the unwary.

The Technique:

Adjust the Phoroptor carefully, respecting the interpupillary distance and the distance of the eyes from the lens discs.

To the dynamic findings in the Phoroptor, fixation having been at 16 inches, add +0.75, D.S., i.e., enough to blur at this distance.

Set the reading test card at 20 inches on the reading rod, i.e., a half-diopter beyond the patient's selected reading distance.

*Submitted on February 12, 1942, for publication in the May, 1942, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

Occlude the left eye and reduce the plus spherical reading addition before the right eye just enough (*and only just enough*) to permit that eye to read the small type.

Occlude the right eye, and proceed as above on the left.

Note mentally or record these monocular findings. If the finding for one eye differs from that for the other, make sure this difference really lies in the eyes and not in faulty technique.

Go back to blur, equally on each eye, maintaining any difference that cannot be reconciled. Then reduce the plus spherical power, binocularly and simultaneously, just enough, not a step more than enough, to permit the small type again being read at 20 inches.

If the monocular and binocular findings are essentially equal and if with these the fine type can still be read with some effort monocularly and binocularly at 13 inches, it follows that the fine type will be read at 16 inches, that a fair reserve and a fair range exist, and that the correction thus arrived at represents the basis of a clinically sound prescription.

The Philosophy:

The temptation is strong to classify the presbyope as a simple case. In theory he may be; in practice he most certainly is not. It is readily assumed that the solution of his ocular problem consists in giving him clear vision at the reading or working point he desires and that this can be accomplished by adding to the distance correction that pair of equal power plus spheres which makes reading clear at the desired point. In theory this may be so; in practice such an assumption is not justified.

Keep in mind that it is the ordinary presbyopic case which is under discussion—not the "grief" (a deplorable term) case—the presbyope who states, and believes he states truthfully, that he holds his work at, say, 16 inches and will be satisfied with whatever gives him clear vision at that point. He is easily satisfied momentarily but too often returns to complain that he cannot see clearly such things as papers on his desk, tools on his bench, or bones in fish on his dinner plate—and so on endlessly, as every experienced practitioner knows.

It is the optometrist's responsibility, not the patient's, to anticipate these reasonable collateral demands and to allow for them in any correction he prescribes.

It will be understood, of course, that some tasks, such as reading music, require separate corrections calculated specifically for distances

intermediate to infinity and normal reading and working points. Also that no presbyope should be permitted to labor under the impression that any but a very limited range of clear vision is to be expected with any correction. The fact that trifocals have been developed to their present stage is significant.

The technique suggested here is considered a practical means of ascertaining a presbyopic correction so delicately balanced as to insure clear, comfortable seeing over that reasonable range needed by almost everyone.

The essence of the technique lies in the selection, *and retention*, of a 20-inch testing distance for a 16-inch reading-point correction, plus a check at 13 inches.

Its practicability becomes evident by reviewing the following steps:

By setting the test card at 20 inches on the reading bar, which is four inches beyond the patient's stipulated reading point. By ascertaining the *highest* plus presbyopic addition that permits fine type being read at this 20 inch point. And by ascertaining that this fine type can still be read at 13 inches, it is obvious that such a correction will afford not only clear vision at 16 inches but some reserve inside that distance and at least 4 inches range outside that distance.

Although a slightly stronger correction will be acclaimed superior by the patient (if, unwisely, he be shown it) as he holds his reading at 16 inches, such a correction will not permit him to see with sufficient clearness the many other things he wishes to see without actually moving them closer or bending forward to bring his eyes closer to them, and without letting go of the work in hand.

This technique is adaptable readily to other than the classical 16 inch reading distance.

If the patient for some definite reason, short arms for example, desires, and will remain satisfied with, a 13-inch reading-point correction, the same technique is followed except that the reading card is set at 16 and 11 inches respectively on the reading rod of the Phoroptor.

If the patient desires an 18 inch reading-point correction, the test card is used on the reading rod at 22 and 14 inches respectively. Slightly larger type may be used to advantage as longer ranges are considered.

In each case, it will be noted, the essential points that of *testing* with the test card set (where the patient cannot move it), first at a dis-

tance equivalent to about a half-diopter beyond and then the same equivalent distance in front of the point at which the actual work is to be held.

Thus for a 16 inch (2.50 D.) reading-point correction, the test is made at 20 inches (2.00 D.) and 13 inches (3.00 D.) respectively.

For a 13 inch (3.00 D.) reading-point correction, 16 inch (2.50 D.) and 11 inch (3.50 D.) test distances are used. And for an 18 inch (2.25 D.) reading-point correction, the test distances are 22 inches (1.75 D.) and 14 inches (2.75 D.), respectively.

If the principle be retained, the *test* distances may be modified somewhat to suit individual choice.

The technique has a negative value in that it discloses the case wherein the correction thus found at 20 inches for *use* at 16 inches has to be increased before the fine type can be deciphered at all at 16 inches. In such a case the technique forewarns the optometrist to forewarn the patient very definitely that his range through the stronger correction that must be prescribed will be limited and will not permit such things as correspondence on the desk to be read as, no doubt, every patient will expect it to do unless *made* to understand otherwise.

Also, if a marked discrepancy is found between the monocular and the binocular findings, a faulty accommodation-convergence relationship is indicated and should take the case out of the classification being considered, namely, the simple presbyope.

Elementary? Of course. So elementary, indeed, as to be widely overlooked. Two courses are open. One, let the patient hold the card at his alleged reading distance while his correction is worked out—and change many corrections after being accused of making a terrible mistake or lose the patient without being given the chance to change to what could have been found in the first place. Two, use the suggested or an equivalent, controlled technique.

Experience indicates that the patient does not exist who can resist the natural impulse to move the test card backward and forward no matter how earnestly implored to hold it at some fixed distance.

Hence the assertion, that otherwise might appear too broad, that this technique cannot be applied under proper control except by means of the Phoroptor, or its equivalent, that is, by some means which insures a known fixed distance being retained between the test lenses and the test card.

HISTOLOGIC OBSERVATIONS OF THE ANGLE OF THE ANTERIOR CHAMBER IN GLAUCOMA*

John E. Asarkoff, O.D., F.D.S.F.O.
Massachusetts School of Optometry
Boston, Mass.

The angle of the anterior chamber is an extremely important region both from the point of view of physiology and pathology, for it is here that the intra-ocular fluids find their most ready exit from the eye: for this reason it is frequently called the "filtration angle." Moreover, it is important surgically, for the limbus forms the usual site of entry in intra-ocular operations.

The angle of the anterior chamber is bounded by the cornea and sclera anteriorly, and by the iris and as a rule part of the ciliary body posteriorly. In this area are two structures which are important in the drainage of intra-ocular fluid from the eyeball; the sinus venosus sclerae, commonly referred to as the Canal of Schlemm, and first described by the German anatomist Frederich Schlemm in 1831, and the meshwork of the angle of the anterior chamber known as the ligamentum pectinatum.

Encircling the eye at the bottom of the scleral furrow there is a venous sinus, the Canal of Schlemm. On section it is oval and often double. Strictly speaking, it is not a canal, but is composed of several lumina which coalesce and re-divide irregularly like a stream which breaks into tributaries and re-combines again. It is lined by a single layer of delicate endothelium, and is separated from the dense scleral tissue in which it lies by a finer layer of richly cellular connective tissue. The canal is surrounded on the outside and behind by the sclera; immediately behind it and to some extent overlapping it internally is the scleral spur; while its inner wall is supported by the trabecular tissue of the angle of

*The author is Instructor in Histo-pathology at the Pathologic Laboratories of the Massachusetts School of Optometry. Submitted on January 15, 1942, for publication in the May, 1942, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

the anterior chamber. It has no direct connection with the anterior chamber, but communicates by many minute branches with an intricate venous plexus situated in the surrounding scleral tissue and derived from the anterior ciliary veins.

On the inner side of Schlemm's Canal and filling up the remainder of the scleral sulcus is the meshwork of the angle of the anterior chamber. This is a trabecular arrangement of intercrossing strands assuming the general form of a triangle; the apex is in the deeper layers of the cornea, the base abruts against the scleral spur and the anterior surface of the ciliary body, the outer side is continuous with the cornea-sclera and forms the inner boundary of Schlemm's Canal, and the inner side bounds the angle of the anterior chamber. It is made up two parts differing in structure; a deeper and larger part, comprising practically the whole of the structure, which has been called the sclera-cornea trabecula and a few delicate elements lying on the inner surface of this, known as the pectinate ligament or uveal meshwork. Particulate matter including cells, are held up by the trabecular network of the angle.

The sclera-corneal trabecula arise in the deeper layers of the corneal lamellae from a circularly arranged bundle of connective tissue and elastic fibres (the "anterior border ring" of Schwalbe). This lies immediately on the outer surface of Descemet's membrane, appearing to be partly imbedded in its substance at the point where this membrane seems to end at the limbus. From this a mass of trabecular tissue runs backwards in triangular form, the outer elements of which find attachment to the scleral spur, while the inner blend with the connective tissue of the ciliary body.

The trabeculae are delicate flat bands of four constituents (according to Salzman). Their basis is formed of collaginous fibres, around which is arranged a thick covering of elastic fibres. This is covered by a fine homogeneous layer continuous with, and having the same staining reaction as Descemet's membrane, while the most superficially are seen as the large nuclei of an endothelial layer continuous with the corneal endothelium and the endothelial vestiges on the iris. Since the trabeculae intercross freely, a large number of spaces are formed between them, each of which is lined by endothelium, and through which the intra-ocular fluids find ready access to the Canal of Schlemm, and come into connection with the corneal tissues and the epichoroidal space. These spaces are referred to as the Spaces of Fontana. Obstruction in this region by sclerosis or other pathological changes is associated with the incidence of glaucoma.

The pectinate ligament is represented by a vestigal remnant of delicate trabeculae which run a curved course like a bow round the angle of the anterior chamber on the inner surface of the cornea-scleral portion. The trabeculae of which it is composed are not flat but round, and have the same histological structure as those of the scleral portion except that the elastic fibres are lacking. At the root of the iris the endothelial elements are continued onwards, the prolongation of Descemet's membrane stops, and the collagenous fibres blend with the connective tissue of the iris stroma. In places the regularity of the angle may be broken by a downward continuation of the iris processes.

The scleral spur is a dense mass of scleral fibres circularly arranged, providing an appearance on section which gives rise to the old name, annular ligament. To its posterior surface is attached the ciliary muscle.

It appears that on contraction of this muscle the scleral spur is drawn backwards, thus opening the lumen of Schlemm's Canal and sucking in the aqueous humor from the anterior chamber. Conversely, when relaxation takes place, the elastic trabecular tissue attached to the anterior border of the spur will pull it back again, thus compressing the canal, the two movements constituting a pump mechanism.[1]

The angle of the anterior chamber of glaucomatous eyes, has excited a great deal of interest since the importance of its inclusion in the etiology of glaucoma was suggested by Weber, and a vast amount of investigation has been expanded upon it by Priestly-Smith, Czermak and others. Fig. 1, and Fig. 2.

As the drain of the eye it is often found to contain detritus left over from some destructive or inflammatory process that has run its course elsewhere within the globe. The anatomy of this region has been subjected to the most minute study.[2,3] Connections can be traced from the Canal of Schlemm not only to the subconjunctival and scleral vessels but also to the veins of the root of the iris and of the anterior part of the ciliary body.

The formation of adhesions between the iris and lens, and between the iris and the posterior surface of the cornea are well known clinical occurrences. When first formed as the result of inflammatory processes,

---

[1]Duke-Elder, S. Textbook of Ophthalmology. Vol. 1. C. V. Mosby Co., St. Louis.

[2]Friedenwald, J. S. Pathology of the Eye. Macmillan Co., New York. 1929.

[3]Henderson, T. Glaucoma. London. 1910.

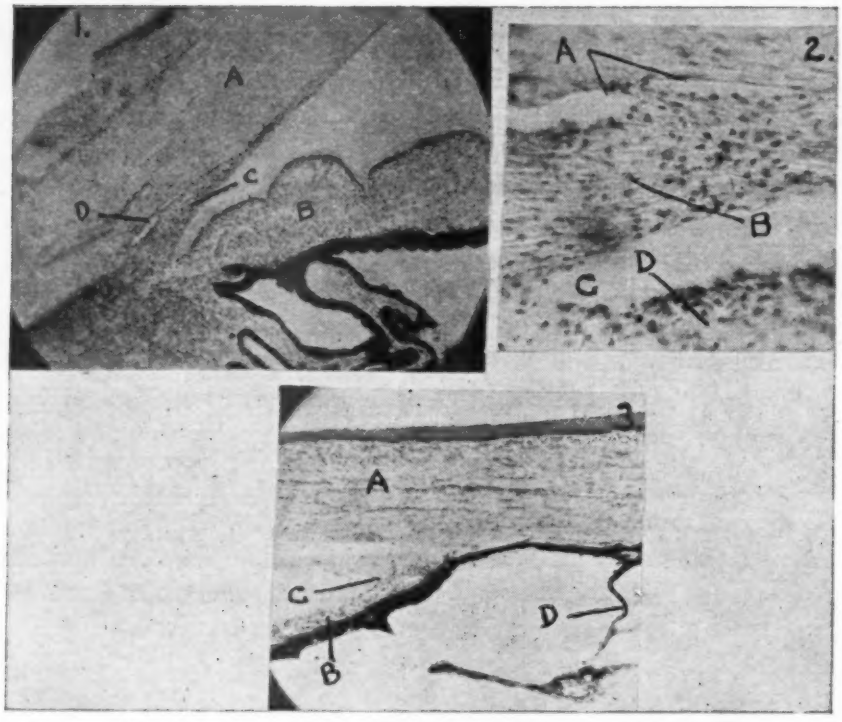


Fig. 1. Normal Filtration Angle. (A) Cornea. (B) Iris. (C) Pectinate ligament. (D) Canal of Schlemm.

Fig. 2. Normal Filtration Angle. (High Power). (A) Canal of Schlemm. (B) Pectinate ligament. (C) Angle of the Anterior Chamber. (D) Iris.

Fig. 3. Buphthalmus. Iris plastered against the cornea and angle is at some distance from the ciliary body and a false angle is formed. Complete absence of the Canal of Schlemm. (A) Cornea. (B) Iris. (C) False Angle. (D) Atrophied Ciliary Body.

the adhesions are only fibrinous. Later they are organized and may become very tough indeed. The mechanism by which the root of the iris becomes adherent to the back of the cornea in glaucoma is somewhat different.

Buphthalmus

Even though the angle of the anterior chamber may appear open clinically, a great variety of malformations may be present. The most common occurrence is a persistence of the foetal condition where both the scleral and the uveal portions of the trabeculae persist. A condition which occurs to some extent in animals (Cross 1896-1899) as a result of this persistence, strands of trabecular tissue or even a mass of con-

siderable density stretches across the angle. A more or less adherence of the iris to the cornea round the periphery[4] may also occur, or more extensive deformations may be found involving an incomplete separation and persistent adherence of the iris and cornea. In addition the Canal of Schlemm and its associated venous network may be absent over part or the whole of the circumference. Fig. 3.

Acute Inflammatory, Acute Congestive and Incompensated Glaucoma

In acute congestive glaucoma only a few eyes have reached histological investigation at an early stage. Iridocorneal adhesions begin to form within twenty-four hours after the apposition of the iris against the cornea and within twenty-four hours to thirty-six hours are so dense that they cannot be broken sufficiently to open the chamber angle except by operation. The adhesions are due to fibrinous exudation as a result of generalized hyperemia.[5]

Friedenwald reported a generalized edema, involving particularly the vascularized tissues. The edema seemed to be due to intense vasodilatation and congestion associated with a perivascular cellular infiltration with a sero-fibrinous extravasation. This was general over the uveal tract but was centered particularly in the ciliary body which had been swollen and approximated the cornea to narrow or obliterate the filtration angle.

Cellular elements, fibrin, and pigment granules are not infrequently found in the aqueous. The iris is pushed forward until the peripheral surface lies in contact with the posterior surface of the cornea. Here an adhesion develops between these two surfaces which are in contact. The more sudden the onset of the attack, and the higher the pressure, the broader will be the adhesion. The adhesion starts in the extreme periphery of the chamber angle, compressing the pectinate ligament and obliterating the space between the iris and the cornea, thus forming a new chamber angle which lacks the filtration function of the normal chamber angle. As in the chronic type of glaucoma the adhesion is mere physical contact between the two tissues, but as time progresses a proliferation of the endothelium of the cornea occurs and an actual tissue adhesion is formed.

---

[4]Parsons, J. Diseases of the Eye. London.
[5]Berens, C. Diseases of the Eye. W. B. Saunders Co., Philadelphia. 1936.

Chronic Inflammatory, Subacute, Chronic Incompensated Glaucoma

In chronic inflammatory glaucoma the anterior chamber is shallow but seldom obliterated. The histologic picture closely resembles that of acute glaucoma with a modification in severity,[5] plus the degenerative changes due to continued hypertension. The mild acute prodromal attacks which very likely are accompanied by edema of the iris and ciliary body, may explain the development of these peripheral anterior synechia.

Chronic Simple, Chronic Non-inflammatory, Compensated Glaucoma

In chronic simple glaucoma, in the early stages, the angle of the anterior chamber is free, or is to some extent infiltrated with cells and pigment.

The study of glaucoma, particularly of the chronic simple type is rendered difficult by the fact that almost all the histological material is represented by eyes which have been excised in the absolute stage of the disease, long after the presence of a high tension has produced extensive and widespread degenerative changes. Some few specimens have been obtained, however, in relatively early stages,[6] particularly in patients who have died from other causes.

Sooner or later it is well known that coincidental with the shallowing of the anterior chamber, adhesions between the anterior surface of the iris and the posterior surface of the cornea are formed in the angle of the anterior chamber. When the adhesions are sufficiently extensive and firm to block the drainage of the chamber angle, an immediate and acute attack of incompensated glaucoma results. But in compensated glaucoma the adhesions are slow in forming, are not annular, and merely limit the drainage of the aqueous without complete blockage. In some instances these adhesions can be seen in the living eye with the aid of the gonioscope, but even when not visible their presence is recognized, as histologic[7] study has shown them to be present in all cases sooner or later.

In chronic simple glaucoma no evidences of inflammation are to be found in any of the ocular structures until the last stages of the disease,

---

[6]Duke-Elder, S. Textbook of Ophthalmology. Vol. 3, C. V. Mosby Co., St. Louis.

[7]Sugar, H. S. Mechanical Factors in the Etiology of Acute Glaucoma. American Journal Ophth. Vol. 28, No. 8, 1941.

when lack of compensation appears in the form of inflammation, the only changes are to be found in the chamber angle and in the optic nerve. Adhesions between the posterior surface of the cornea and the anterior surface of the iris, so characteristic of the incompensated forms of glaucoma are not primarily present. In some cases the individual fibres of the pectinate ligament are somewhat thickened and sclerosed so that the character of the filter is changed and the total filtering area is lessened. Fig. 4 and Fig. 5.

Because of the fact that Henderson was able to demonstrate, in many cases, this thickening of the fibres of the pectinate ligament which was occasionally sufficient to cut off the aqueous fluid from Schlemm's canal, he regarded this as the primary cause of glaucoma, and felt that shallowness of the anterior chamber could be explained as the result

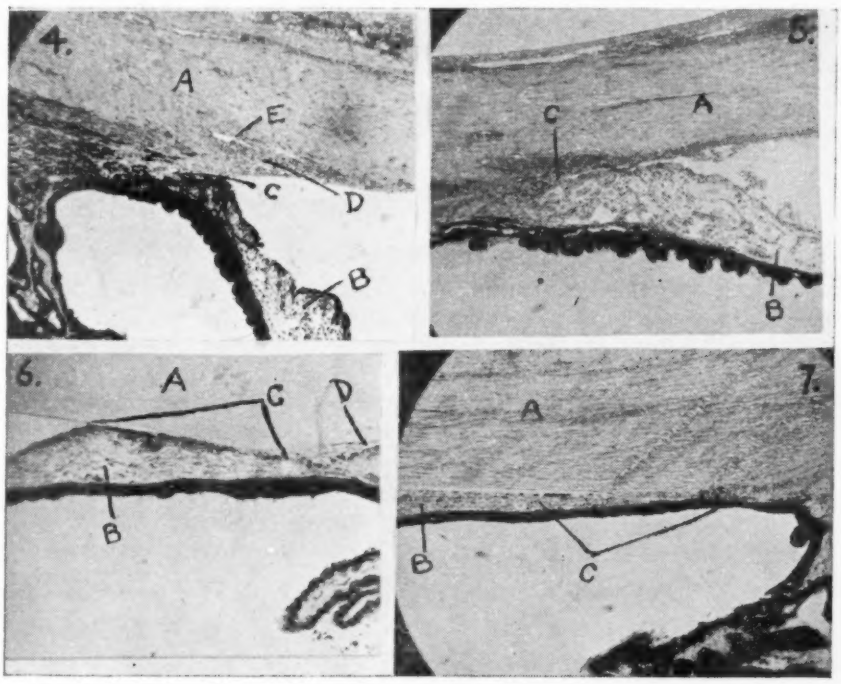


Fig. 4. Chronic Simple Glaucoma. (A) Cornea. (B) Iris. (C) Small peripheral anterior synechia. (D) Sclerosis of pectinate ligament. (E) Canal of Schlemm.

Fig. 5. Glaucoma. (A) Cornea. (B) Iris. (C) Fresh peripheral anterior synechia.

Fig. 6. Absolute Glaucoma (Blind Eye). (A) Cornea. (B) Iris. (C) Extensive anterior synechia. (D) Complete Occlusion of Canal of Schlemm.

Fig. 7. Absolute Glaucoma. (A) Cornea. (B) Iris. (C) Extensive anterior synechia.

of increased intra-ocular pressure. While these anatomical studies are undoubtedly of great importance, and while sclerosis of the pectinate ligament is often seen in glaucoma it still remains unproven that this is the primary cause, for many cases of glaucoma are seen in which no such lesion is found.

Leber suggested the theory that closure of the angle of the anterior chamber, through adhesions between the iris and cornea, was the fundamental factor. How the iris gets into this position and how these adhesions develop remains unexplained, but that these adhesions when once formed, contribute to the maintenance of the increased intra-ocular pressure would seem fairly well established. They are found with great regularity in cases of long standing glaucoma, but in early cases they are usually absent, so that the formation of the peripheral anterior synechia in chronic simple glaucoma still remains unexplained. The generally accepted opinion of its almost invariable closure depends on the histological reports of eyes removed in the latest stage of the disease.

Absolute Glaucoma

In advanced glaucoma the changes invariably found at the angle of the anterior chamber include hyalinization of the pectinate ligament, a deposition of pigment sometimes in considerable quantity in the meshes of the pectinate ligament (Levinsohn), and adhesions between the root of the iris and the posterior surface of the cornea. When the adhesions are fresh, as stated previously, they consist merely in cohesion of the cells of the two structures but when of long standing the adhesions become very dense and fibrous so that it is impossible to separate the iris from the cornea. In such cases the corneal endothelium often grows over the surface of the iris and a continuation of Descemet's membrane may develop under the epithelium. In the meantime the iris becomes fibrous and atrophic. Fig. 6 and Fig. 7.

Secondary Glaucoma

Secondary glaucoma is that type of glaucoma which follows some other disease of the eye. There are many different conditions which may cause this disease and amongst the chief offenders are: acute iritis, intra-ocular tumors, thrombosis of the central retinal vein, dislocation of the lens, etc. Fig. 8.

Acute iritis may bring about secondary glaucoma by causing a mechanical obstruction of the angle of the anterior chamber by the

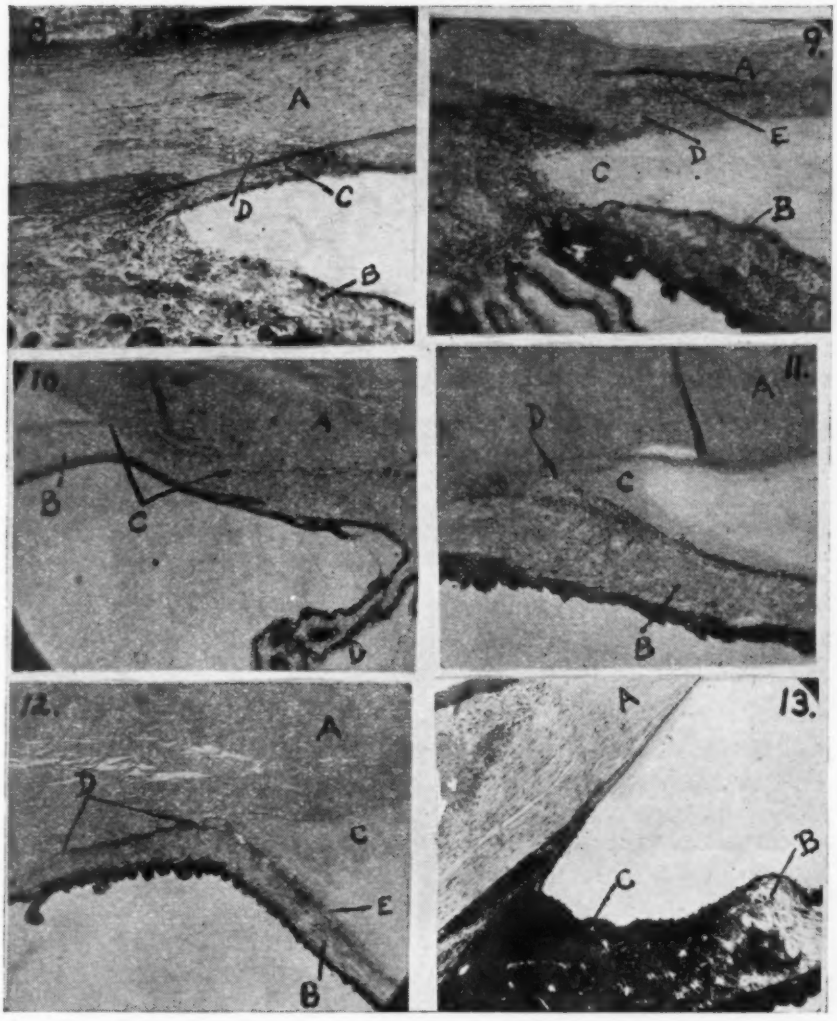


Fig. 8. Secondary Glaucoma. Sclerosis of the pectinate ligament the meshwork of which is blocked by cells. Obliteration of Canal of Schlemm. Angle of the anterior chamber is open. (A) Cornea. (B) Iris. (C) Pectinate ligament. (D) Canal of Schlemm.

Fig. 9. Chronic Iritis and Cyclitis. Iris angle open, meshwork blocked by cells. (A) Cornea. (B) Iris. (C) Angle of the anterior chamber. (D) Meshwork of pectinate ligament. (E) Canal of Schlemm.

Fig. 10. Secondary Glaucoma. Extensive anterior synechia. Slight round cell infiltration of ciliary body. Old degenerated eye. (A) Cornea. (B) Iris. (C) Anterior synechia. (D) Atrophied ciliary processes.

Fig. 11. Secondary Glaucoma. Diabetic Iritis. Blood and coagulum in anterior chamber. Anterior synechia. (A) Cornea. (B) Iris. (C) Coagulum in anterior chamber. (D) Anterior synechia.

Fig. 12. Hemorrhagic glaucoma following thrombosis of central retinal vein. Coagulum in anterior chamber. Peripheral anterior synechia. Fibrous membrane on anterior part of iris with vessels in it. (A) Cornea. (B) Iris. (C) Coagulum. (D) Anterior synechia. (E) Fibrous membrane on Iris.

Fig. 13. Melanosarcoma of Iris and Ciliary Body. (A) Cornea. (B) Iris. (C) Melanosarcoma occluding filtration angle.

swollen iris or by blockage of the meshes of the pectinate ligament by insoluble masses of albumin or fibrin. Fig. 9, Fig. 10, Fig. 11.

Pathological examinations in thrombosis of the central retinal vein, have shown that an intense inflammatory reaction occurs in the anterior segment of the globe[8] so that the iris and the spaces of Fontana are packed with inflammatory exudates and cells while later, highly vascularized membranes cover the iris and line the angle of the anterior chamber. This type of secondary glaucoma is referred to as hemorrhagic glaucoma. Fig. 12.

Intra-ocular tumors may cause secondary glaucoma by mechanical obstruction of the angle of the anterior chamber due to a bulging forward of the iris root, or to obstruction of the filtration by ingrowth of the tumor cells into the pectinate ligament or other tissues concerned in the filtration process of the angle. Fig. 13. I wish to express my thanks to Dr. Max Hershman for his willing and able assistance in preparing the photomicrographs.

[8]Samuels, B. Pathological Changes in Anterior Half of Globe in Cases of Obstruction in Central Vein of Retina. Arch. Ophth., Vol. 13, No. 3, 1935.

A STEREOSCOPIC METHOD OF MEASURING HYPER-CYCLOPHORIA*

S. Herman Shurin, Opt.D., F.A.A.O.
Kansas City, Mo.

Introduction

In making tests which will reveal the true state concerning the absence or presence of hyperphoria or cyclophoria we must, as optometrists, take into consideration the following:

(1) In measuring hyperphoria, the question is, can the patient judge true horizontal continuity when fusion is suspended by means of a displacing prism; or is he capable of estimating an exact center when using the maddox rod and the spot-of-light test?

(2) In measuring cyclophoria, the question is, can the patient estimate correctly, true parallelism or perpendicularity, when using the maddox double prism or the maddox rods and displacing prism or crossed maddox rods?

(3) If either of these two phorias is present, the question then arises as to whether there is any influence on the hyperphoria by the cyclophoria, or upon the cyclophoria by the hyperphoria? Considering, at the same time, that each condition is a separate entity instead of associated abnormalities as they usually are. Also whether or not the compensation of the hyperphoria alone, by means of a vertical prism, may produce the ocular comfort sought for?

(4) Another problem is that of instrumentation. Outside of research centers or large clinics, it is often a difficult matter to obtain the necessary equipment which will fulfill the following requirements:

---

*An abridgment of the material presented before the American Academy of Optometry at Chicago, Illinois, December 9, 1941, for publication in the May, 1942, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

Published with the permission of the copyright owner, Dr. S. Herman Shurin, Chamber Bldg., Kansas City, Mo.

(a) Correct enough in principle to be of sufficient accuracy so that reliance may be placed in the reports of the patient for clinical purposes. (b) Inexpensive enough to justify its inclusion in the armamentarium of the optometrist. (c) Simple enough so that the optometrist or his assistant can make the needed tests both easily and quickly. (d) Instructions in the application of the test must be so simple that the patient will readily understand what is expected of him and be able to promptly and properly reply, no matter how low his mental capacity may be. (e) A correct method of computing or estimating the prevailing condition must be found. (f) If certain results are to be considered as our norms, then the great majority of our patients must show findings within those expecteds. (g) A similar condition should be shown to exist if an attempt were made to verify the condition on other equipment, although it need not be shown as accurately as on the apparatus which has been developed for the purpose, and the interaction of the hyperphoria and cyclophoria may alter the findings of either or both tests. (h) The tests must be applicable at different distances; each of which must be actually present in space or at its geometric equivalent.

As an answer to the above conditions, a simple slide was developed. (Fig. 1.) This slide is inexpensive; accurate; easy to explain to the patient; simple to compute the findings from; it measures the hyperphoria and the cyclophoria simultaneously if present; it can be used at different distances, and does not depend upon the patient's judgment of parallelism, perpendicularity, or idea of exact bisection.

Principle

Instrument needed: A stereoscope of precise workmanship; there must be no tilting sideways of the slide-holder, and the optical centers of both lenses must be level.

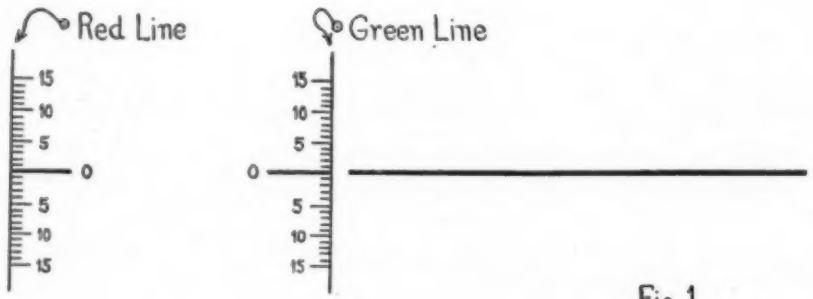


Fig. 1.

A slide was designed[1] long enough to be placed before both eyes simultaneously. On this slide, in front of one eye is a long black horizontal line. Before the other eye are two vertical lines of contrasting colors, as red and green for identification. Upon each of these vertical lines is placed a heavy black horizontal mark exactly opposite the long horizontal line which was placed in front of the other eye. Above and below these two heavy marks on the vertical lines, a number of small black markers are placed, 1 mm. apart, for a distance of 3 cm. both up and down. These two vertical lines are placed 57.25 mm. apart. This distance was selected for this reason: 1° is our standard of measurement for cyclophoria. We would like to use 1 mm. to represent 1° inasmuch as it is a simple linear measurement. The formula is: Tan 1° = 0.01746; 1 mm./0.01746 = 57.25 mm. The displacement of the horizontal line, in number of spaces on the vertical line, will give us the number of degrees of cyclophoria if any is present. The slide will also inform us of the amount of hyperphoria present either alone or in conjunction with cyclophoria.

As the spaces indicated on the vertical lines are 1 mm. apart these can also be interpreted in terms of prism diopters (△). This is solved by the use of the following formula:[2]

$$x = PD_d \cdot a$$

in which PD_d is the prism diopter value of 1 mm. and a is the number of mm. from zero or orthophoria position. The prism diopter value of 1 mm. is found by the use of the following formula:[3]

$$1 \text{ mm.} = PD = \frac{Dl_s \div Da_d}{10}$$

in which PD is prism diopter value; D is Diopter value; ls is lens in stereoscope; d is given distance; and a is accommodation needed.

Method of Use

With the light turned on in the instrument, the patient seated in proper position before it, either with or without his correction (depending on how the test is to be made), the slide is inserted in position at the infinity mark. Care must be taken that the patient shall not press too hard upon the instrument as pressure on the patient's cheeks may be passed on to the globe of the eye or eyes and thus give the examiner a false reading. If glasses are used in making the test it is important that these be in alignment, for if these are out of adjustment this may

also affect the findings. The slide is usually placed so that the horizontal line is in front of the right eye of the patient, the vertical lines being in front of the patient's left eye. The left eye is then occluded, attention being directed to the horizontal line. The right eye is then occluded and the left uncovered, attention being directed to the two vertical lines.

The right eye is then uncovered and the patient is asked if the horizontal line passes through the right vertical line at the central heavy black mark, or whether it is above this mark or below it. This is repeated for the left vertical line. If the horizontal line crosses both heavy black marks on the two vertical lines the patient is free from both hyperphoria and cyclophoria. If it crosses above or below the heavy marks, the question then is, at what point either above or below the heavy black mark the horizontal line crosses. This finding is recorded for both the right and left vertical line. The slide holder with the slide is now moved in to the near point equivalent and the test is repeated. This concludes the test as far as the patient is concerned.

Interpretation of the Findings

1. If the finding shows that the horizontal line crosses both vertical lines the same number of spaces either above or below the central black marks, there is only hyperphoria to consider.

2. If the finding shows that the horizontal line crosses one vertical line as much above the central black mark as it crosses the other below the central black mark, there is only cyclophoria to consider.

3. If the finding shows that the horizontal line crosses one vertical line, either higher or lower, above or below, the central black mark, than it crosses the other vertical line, there is both cyclophoria and hyperphoria present.

4. If the horizontal line is placed before the right eye and it appears to be higher than the central black marks there is left hyperphoria present. If lower, right hyperphoria. If it is seen higher on the right vertical line than on the left there is positive or plus-cyclophoria present. If lower on the right vertical line than on the left there is negative or minus-cyclophoria present. A combination of several of these may be present.

Calculation of Cyclophoria

The cyclophoria amounts to the algebraic difference between the

position of the horizontal line on the two vertical lines. Thus if the report is, that the horizontal line crosses the right vertical line at *n* spaces above the central black mark, and at *n* spaces below the central black mark on the left vertical line, then there is present $2n^{\circ}$ of positive or plus-cyclophoria. This method of calculation of the rotation will hold good at both infinity and at 16 inches.

Calculation of Hyperphoria

If the reading is equally high on both vertical lines, or equally low, then there is no algebraic difference and only hyperphoria exists. The number of mm. on either vertical line of displacement from the central black mark is converted into prism diopters according to the formula already presented.

Calculation of Hypercyclophoria

If the readings in the amount either above or below the central black marks (such as 2 above on one side, and 4 below on the other), are different, then the algebraic difference between them is the measure of the cyclophoria, and the vertical displacement of the mean indicates the amount of hyperphoria associated with this cyclophoria, and a different calculation will have to be made for various positions of the slide holder, as in any stereoscope. For instance, in the telebinocular, from the formula previously given, with the target at the 16 inch position, each mm. of displacement has a prism diopter value of 0.75 and the finding should be multiplied by that amount to arrive at the true figure of hyperphoria, whereas at the infinity position of the slide holder each mm. of displacement has a value of 0.50.

Because of projection, the hyperphoria will be right hyperphoria if the figure seen with the right eye is lower than that seen with the left eye, and the hyperphoria will be left hyperphoria if the figure seen with the right eye is higher than that seen with the left eye.

The cyclophoria which is found will be negative cyclophoria if the vertical meridians are inclined towards each other at the top. This is demonstrated in projection by the left side of the image of the right eye being tilted upward or clockwise. The converse is also true indicating positive cyclophoria.

Conclusion

It is true that there may be present an exophoria or an esophoria

which may influence the findings just outlined. For practical purposes we are assuming that all rotation takes place at the midpoint between the two vertical lines. After all, if there were no interference in these visual functions, we would encounter no hyperphoria or cyclophoria. With the suggested technique we are only measuring those anomalies which are revealed by this particular test on the instrument mentioned, at the time of the examination. The expected finding is, no cyclophoria and no hyperphoria at any distance at which the test is applied.

REFERENCES

[1]S. Herman Shurin. Cyclophoria and Cycloductions. Annals of the Distinguished Service Foundation of Optometry. Vol. 1, No. 2, p. 75. 1935.

[2]S. Herman Shurin. Prism Diopter Value of Various Distances. Optometric Weekly. Vol. 27, p. 741. 1936.

[3]S. Herman Shurin. The Prism Diopter Value of 1 Millimeter. New York State Year Book of Optometry. p. 331. 1936.

DISCUSSION

DR. WILLIAM B. NEEDLES, CHICAGO, ILLINOIS: I find myself very much interested in several phases of this question. So far as I can observe, the test outlined, should be accurate. It should quickly reveal the condition that it is designed to measure. It could be very well combined with the method of measuring the esophoria or exophoria in conjunction with these conditions by graduating the horizontal line, as well as the vertical. It should be a very simple matter for one to design his own cards, and I can see no reason why the test as Doctor Shurin has presented it, cannot be made as rapidly as any of the other tests that we have for the measurements of these conditions. In my judgment he has done an excellent piece of work in developing the formula or the calculation of the significance of the phenomena as these are revealed in the making of the tests.

I can assure Doctor Shurin that we at the college will design a number of cards and will carry on a series of experiments with them and will undertake to determine the exact accuracy of his methods of measurements. If there are any faults whatever with his procedure, we will work these out with him. Any comments I have been in a position to make now, are the results of listening to his presentation.

DR. R. J. BEITEL, JR., SOUTHBRIDGE, MASS.: I should like to ask whether you have made measurements of patients and then reversed the relative position of the lines on the test card, to find out to what extent

the findings may be duplicated?

DR. S. HERMAN SHURIN, KANSAS CITY, MO.: In the original report, I had this data. This material has been published by the Distinguished Service Foundation of Optometry. I found little or no variation in the findings.

DR. R. E. BANNON, HANOVER, N. H.: Have you found that if you correct some or all of the exophoria, for instance, at the near-point, that your measurement of the cyclophoria and hyperphoria will differ? That is, if there is a cyclophoria as shown by a tilting of the horizontal line, your interpretation of whether or not there is a vertical phoria will depend on where this tilted horizontal line crosses the two vertical lines. Now, there is not sufficient horizontal fusional element present to prevent the tilted horizontal line from swaying or moving laterally, is there?

DR. S. HERMAN SHURIN, KANSAS CITY, MO.: It does check with it so to date. I have tried on occasion to incorporate an element, in the design of the slide, that would take advantage of fusion. I considered a number of ways to do this. Among them, was that of placing a square before one eye and a circle before the other, having them so placed as to coincide when viewed through the stereoscope. As far as I am concerned, I did not find much practical value in this. When viewing the slide, after the initial movement of the horizontal line, it seems to stay in one position fairly well.

DR. R. E. BANNON, HANOVER, N. H.: Does the measurement of the hyperphoria that you find with your new slide, agree with other measurements taken of hyperphoria on the same patients, at the same time?

DR. S. HERMAN SHURIN, KANSAS CITY, MO.: It does check with the findings of other tests to a very marked degree.

DR. M. THOMA EBERL, MILWAUKEE, WIS: I would like to add to what has been said, that we have used the new slide of Doctor Shurin, in our office since the spring of 1941. We have found it quite a valuable additional test to indicate the presence or absence of cyclophoria.

ADDITIONAL STEREOSCOPIC CHECK TESTS TO ACCOMPANY THE STEREOSCOPIC METHOD OF MEASURING HYPER-CYCLOPHORIA*

S. Herman Shurin, Opt.D., F.A.A.O.
Kansas City, Mo.

Pursuant to the discussion which followed the presentation of the foregoing paper, the following material is added, for use in measuring cyclophoria without regard to hyperphoria. The slides presented herewith (Fig. 2 and Fig. 3), may be of value inasmuch as there may be present in certain cases a change in the patient's lateral position of regard while viewing the slide through the stereoscope which might influence the finding to some extent. The new slides would readily check this condition.

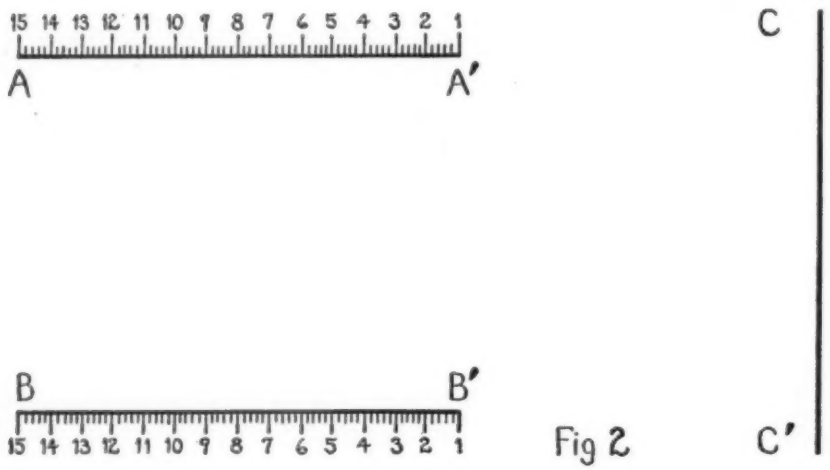


Fig 2

Construction

In Figures 2 and 3, horizontal lines AA′ and BB′ are parallel, their separation being 57.25 mm. The dots composing these lines are 1 mm. apart, the dots marking each 5 mm. position being slightly longer than the others.

The vertical line CC′ is exactly perpendicular to the lines AA′ and BB′, and also to the beginning and ending of the dots which are congruent.

*Submitted on January 6, 1942, for publication in the May, 1942, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

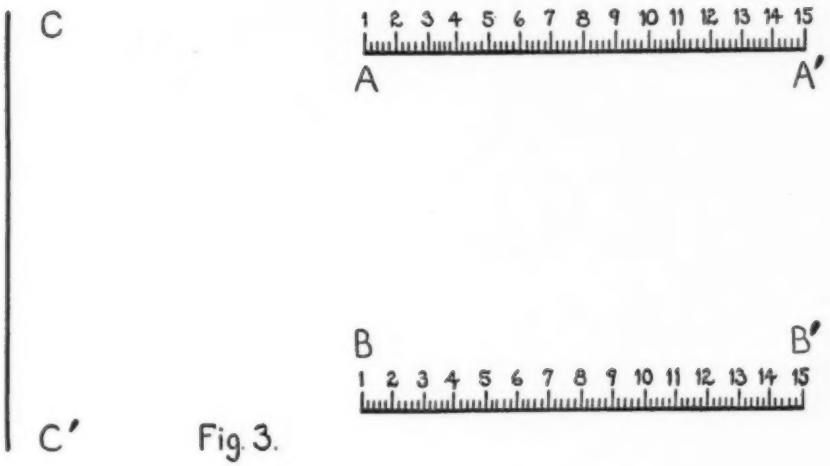


Fig. 3.

In Figure 2, the vertical line is placed before the patient's right eye. In Figure 3, the vertical line is before the left eye.

Computation and Interpretation

(1) Cyclophoria. The algebraic difference between the two parallel lines, AA′ and BB′, subtended by the position of the vertical line CC′, is equivalent to the cyclophoria in degrees. If the vertical line is in front of the right eye (Fig. 2), and the reading is greater on the lower line than on the top line, positive cyclophoria exists. If the reading is greater on the top line than on the lower line negative cyclophoria exists. If the vertical line is in front of the left eye (Fig. 3) and the reading is greater on the lower line than on the top line, negative cyclophoria exists. The converse is also true for positive cyclophoria.

(2) Stereo-esophoria and stereo-exophoria. If a position of lateral orthophoria were to be established, then if there is no difference between the readings on the two horizontal lines, no cyclophoria exists, and the stereo-esophoria or the stereo-exophoria may be computed by ascertaining the difference between the stereo-orthophoria and the readings, and computing the phorias by the same formula as used in the computations on the preceding slide.

(3) Stereo-cyclo-esophoria and stereo-cyclo-exophoria. Here the stereo-cyclophoria is still to be calculated as in section (1) above. The midpoint between the two positions may represent the point from which to calculate the lateral phorias.

A TELESCOPIC METHOD OF OPHTHALMOSCOPY*

Mathew B. Alpern, O.D.
Eye Clinic, Northern Illinois College of Optometry
Chicago, Illinois

Occasionally in the course of his clinical practice the eye specialist desires to examine the fundus of a patient in more detail than is offered by the magnification of the direct method of ophthalmoscopy. To date the clinician has been limited in this respect since the average office does not have the apparatus by means of which this might be effected. It is the purpose of this paper to describe a simple clinical method by means of which a magnification of thirty-five times may be obtained. For want of a better name the technique has been called the telescopic method.

The classic description of the three methods of using the ophthalmoscope as found in Emsley[1] are: 1. Direct method. 2. Indirect method. 3. Distance. Of these three only the first two are of interest in this paper.

The direct method allows the image of the patient's fundus to be seen by causing the direct conjugation between the retinae of the patient and the examiner.[2] Assume the patient and the examiner to be emmetropic and the two eyes to be separated by a distance equal to the sum of their primary focal lengths. We may diagram this as in figure one.

By means of this diagram we note that the image is virtual and erect. The distance in space in which the image is located is ascertained by the law of monocular projection. Since the object is within the examiner's near point, the image is projected to the plane of most distinct vision. That is, a plane behind the patient's eyeball at a distance of approximately fourteen times the distance of the object from the observer. This ratio of the image distance to the object distance may be defined as the

*The writer wishes to acknowledge thanks to Dr. I. M. Borish, Dr. I. M. Brenner and Dr. Eugene Freeman for their aid in formulating this paper. Appreciation is also expressed to Dr. Glenn A. Fry and Dr. Richard M. Hall for their helpful suggestions. Submitted on January 5, 1942, for publication in the May, 1942, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

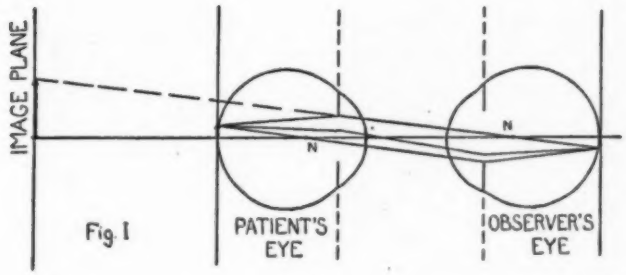


Fig I

Lateral Magnification and may mathematically be represented by the following relationships:*

$$Y = \frac{u'}{u} = \frac{y'}{y}$$

Where u = Object distance
u' = Image distance
y' = Size of image
y = Size of object

$$-u' = -14u \quad \text{Therefore} \quad Y = \frac{-14u}{-u} = +14X$$

Since the image and object distances are both minus, the sign of Y will be plus and the image will be virtual and erect for a real object.

In the indirect method, magnification is produced in a slightly different manner than in the direct method. We study the fundus not by looking directly at it but by observing the aerial image (which is real and inverted) formed by a plus lens held between the ophthalmoscope and the patient's eye.

In figure two, let L be the convex trial lens having a focal length of 75 mm. It is held at a short distance from the patient's eye (which we assume is emmetropic) so that the parallel light rays leaving the patient's eye will strike the lens and will focus at its secondary focal plane and form in this plane a real and inverted image.

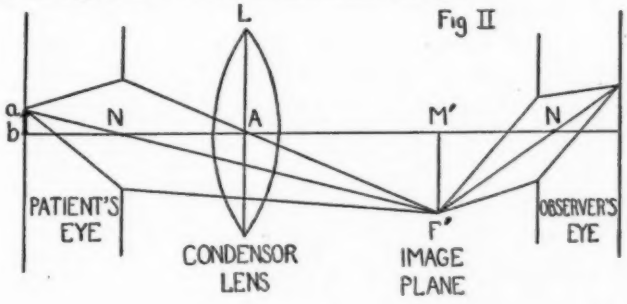


Fig II

Now the examiner's eye will be placed at a certain distance (about 8 in.) from this image in space and, as a result, in order to see the image clearly the examiner must exert about 5.00 diopters of accommodation. If the examiner be presbyopic or if it is desirous to relax all accommodation, the image may be seen clearly by placing a 5.00 diopter lens in the ophthalmoscope. Since the object viewed by the examiner is well outside his effective near point, the image will be projected to the same plane as the object; i.e., the focal plane of the condenser lens, by the law of monocular visual projection. The magnification in this situation will thus depend upon only the magnification produced by the condenser lens. Since light from the emmetropic eye emerges parallel, any ray such as AF′ (figure two) that can pass through the optical center of the lens must always make the same angle with the axis, and the aerial image must always be formed at the focal plane (M′F′) of the lens.[5]

$$\text{Therefore, angle aNb} = \text{angle M′AF′}$$

$$\text{and} \quad Y = \frac{M'F'}{ab} = \frac{AM}{Nb}$$

$$\text{If } AM' = 75 \text{ mm. (focal length of lens)}$$
$$\text{and } Nb = -15 \text{ mm. (approximately)}$$

$$\text{Therefore,} \quad Y = \frac{75}{-15} = -5$$

Since Nb is a minus distance and AM is plus, the sign of Y is minus showing the image to be real and inverted and five times the size of the object.

In comparing the two methods we find that in the direct method the image is virtual, erect and highly magnified while the field of view is correspondingly reduced. In the indirect method the image is inverted, real, and magnified only to a limited extent while the field of view is decidedly increased.

In cases of minute pathological fundus conditions, early stages of gross pathology of the fundus, or abnormality of small retinal and choroidal vessels, it is of definite advantage to see a limited portion of the fundus under higher magnification than usually obtainable, and this advantage is afforded by the telescopic method of ophthalmoscopy.

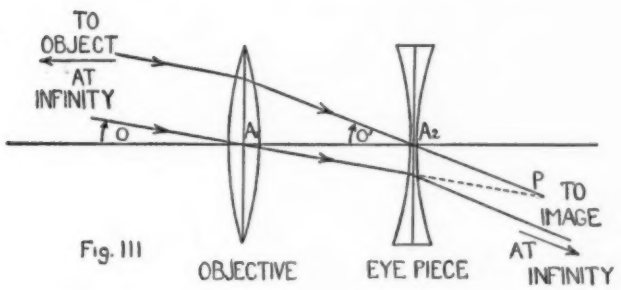


Fig. 111

The simple Galilean or Dutch telescope (figure three) is made up of a system of two lenses—a plus and a minus lens separated by such a distance that the secondary focal point of the objective (or plus lens) coincides with the primary focal point of the ocular (or minus) lens. Parallel rays of light striking the system from an infinitely distant object will be refracted by the objective lens so as to focus at the secondary focal point of the lens. However, the ocular lens causes the convergent pencil of light to be diverged to parallelism when it leaves the system. The magnification in this type of a telescopic apparatus is due to the fact that the apparent size of the object (Ø) is smaller than the apparent size of the image (Ø') so that we represent the magnification by the following relationships:[3]

$$Y = \frac{\tan Ø'}{\tan Ø} = \frac{-f1}{f2} = \frac{-F2}{F1}$$

Since the eyepiece is minus, the sign of Y will be plus and the image will be erect and virtual.

We may readily apply this principle to ophthalmoscopic technique. If we use as an eyepiece a minus 25.00 D. lens in the ophthalmoscope head, and as an objective a plus 10.00 D. trial lens held in front of the ophthalmoscope at a distance of 6 cm., we will notice immediately the increase in the apparent size of an infinitely distant object viewed through this system. According to the magnification relationship, the increase of the apparent size, that is, the magnification, may be shown by the following equation:

$$Y = \frac{-F2}{F1} = \frac{-(-25)}{+10} = +2.5X$$

From this it will be seen that the size of the image will be 2.5 times the size of the object. Since the dioptric power of the eyepiece is

minus, the sign of Y will be plus so that the image will be erect and virtual.

To view the fundus of an emmetropic patient through this system it is necessary to get as close as possible to the eye of the patient in order to get the maximum field of view (figure 4). When this situation exists there is a distance of approximately seven centimeters separating the observer's eye from the fundus of the patient. The image of the patient's fundus on the examiner's retina is 2.5 times the size of the object due to telescopic system as shown above. Since the image is virtual and erect and within the observer's near point (as it was in the direct method) the observer must project to the plane of most distinct vision the image seen (just as he does in the direct method). Thus it will be seen that the magnification factor in this situation is dependent not upon one variable (as it is in the direct and in the indirect method) but upon two. These two variables are: 1. An increase of apparent size of the image due to the physical or optical properties of the telescopic apparatus and, 2. An increase in the image distance over the object distance, due to psychological projection of the image to the plane of most distinct vision. The total magnification is a product of these two independent variables.

Thus, since $F2 = -25$ $F1 = +10$ and $-u' = -14u$

Y = (magnification due to telescope)
x (magnification due to projection)

$$= (M1)\ (M2)$$

$$= \frac{-(F2)}{(F1)}\ \frac{(u')}{(u)}$$

$$= \frac{-(-25)}{(10)}\ \frac{(-14u)}{(-u)} = (2.5)\ (14) = 35X \text{ Approximately}$$

Consequently, a virtual and erect image is formed which is approximately 35 times the size of the object. The optics of the arrangement are diagrammed in figure four.

If either the patient, the observer, or both are ametropic the telescopic setup must have the dioptric power required to compensate for the refractive errors present and at the same time given a magnification of the image. According to Morgan,[4] we may represent this magnification

of any telescopic system having a dioptric power by the following formula:

$$Y = \frac{1}{1 - dF1 - zFe}$$

Where
F1 = Power of objective
Fe = Equivalent dioptric power of lens system
d = Separation of eyepiece and objective in meters
z = Separation of eyepiece and observer's center of rotation in meters

From this formula it may be seen that it is possible to keep F1 and Y constant, while d and z may be varied within limits to give any desired value for Fe necessary to compensate for errors of refraction present.

The arrangement of the telescopic method of ophthalmoscopy has a decided advantage in that it gives a much larger image for an almost infinitesimally small object. The erectness of the image is perhaps of additional value. The disadvantage of this method is that it affords an extremely small field of view. While the technical skill required is no greater than for the conventional indirect method of ophthalmoscopy, it does demand a much higher degree of skill than the simple direct method does.

There is available on the market a telescopic attachment for ophthalmoscopes, which embodies the basic principle of the method just outlined. This attachment gives approximately the same magnification as is obtained by the cruder apparatus herein described, and is easier to manipulate inasmuch as the elements of the telescope remain fixed.

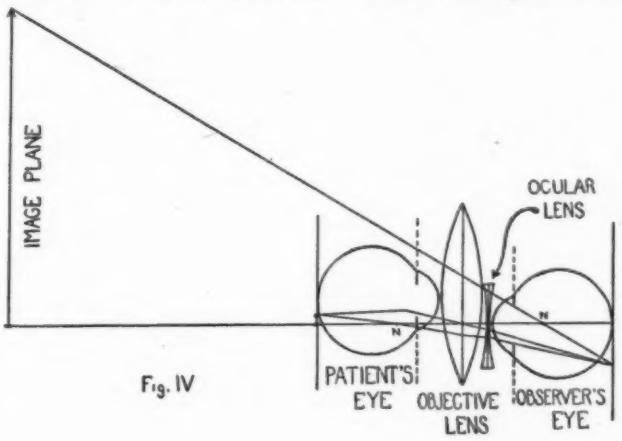


Fig. IV

Undoubtedly this is not the first description of the telescopic method to appear in ocular literature. However, an exhaustive study of the classical and contemporary works failed to reveal any previous report on this method. Therefore, insofar as it is possible to ascertain, the exact date and nature of the first historical publication on this subject is unknown.

SUMMARY

Clinicians often have occasion to view the fundus of a patient under magnification higher than the 14X afforded by the direct method of ophthalmoscopy. This can best be accomplished by employing the Galilean telescopic principle. Placing a plus 10.00 trial lens a distance of about six centimeters from a minus 25.00 diopter lens in the ophthalmoscope gives an erect image X35 of the fundus of an emmetropic patient. Although this method gives an extremely small field of view, it is of definite advantage in studying those cases of fundus pathology confined to a very small area of the retina. It is applicable to both ametropic and emmetropic patients. In conclusion, it is advisable to state that this method is not recommended to replace the known and tried techniques; it is offered only as a supplementary routine to be used in proper correlation with the usual ophthalmoscopic procedures.

BIBLIOGRAPHY

1. Emsley, H., *Visual Optics*, Hatton Press, Ltd. (II Edition) London, 1939.
2. Borish, Irvin W., *Outline of Optometry*, V. J. Le Gros & Co., Chicago, 1938.
3. Southall, James P. C., *Mirrors, Prisms and Lenses*, The Macmillan Co., New York, (Third Edition) 1933.
4. Morgan, Meredith W., *Optometric Optics*, University of California Press, Berkeley and Los Angeles, 1940.
5. Laurance, Lionel and Wood, H. Oscar, *Visual Optics and Sight Testing*, The School of Optics, Ltd., London, 4th Ed.

*Note: The convention of sign, nomenclature and mathematical symbols used throughout this paper are those employed by J. P. C. Southall in *Mirrors, Prisms and Lenses*. For further explanation of basic optics the reader is referred to this volume.

AMERICAN JOURNAL OF OPTOMETRY
and ARCHIVES *of*
AMERICAN ACADEMY OF OPTOMETRY

Established 1924

Vol. 19 MAY, 1942 No. 5

EDITORS AND STAFF

Dr. Carel C. Koch . . . . . Editor and Publisher
Dr. Guy L. DuPlessis . . . . . Associate Editor
Dr. Clarence W. Morris . . . . . Associate Editor
Dr. J. Fred Andreae . . . . . Academy Secretary
Lenore Pulver . . . . . Editorial Assistant
Harry Brookins . . . . . Advertising and Production Manager
Lilly L. Koch . . . . . Circulation Manager
Publication Office: 1501-1504 Foshay Tower, 821 Marquette Ave., Minneapolis, Minn.
Academy Office: 901-903 Lexington Building, Baltimore, Maryland.

Annual Subscription, $4.00 in Advance; Canada, $4.50; Foreign, $5.00;
Single Copies, 50c.

Original papers, scientific communications, clinical reports, books for review, and correspondence should be sent to the editor. Subscriptions and applications for single copies should be addressed to the circulation manager. Copy of advertisements must be sent in by the first of the month preceding their appearance. Communications with reference to advertising or other journal business should be addressed to the advertising manager. Academy correspondence should be addressed to the Secretary of the American Academy of Optometry.

Published Monthly by the
AMERICAN JOURNAL OF OPTOMETRY PUBLISHING ASSOCIATION

The American Academy of Optometry and the publishers of this journal have no objection to the reprinting, by other magazines, of any of the articles in this issue, provided such reprints are properly credited to the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

AN OPHTHALMOSCOPIC ROUTINE

The following routine of an ophthalmoscopic examination is formulated to cover the normal or non-pathological eye and its more common physiological variations which the inexperienced ophthalmoscopic observer frequently confuses with pathology. In the content of this paper there will be relatively little description, discussion or illustration except for reference to ophthalmological writers. Nor will this paper include any discussion of the congenital anomalies of the disc, macula, fundus or vessels. Our purpose is to outline, in as few words as possible, an optometric routine for ophthalmoscopic examination. In this field we recognize the pre-eminence of the medical profession and for the most part cite ophthalmological writers as authority for the material in the following outline.

The reader must also bear in mind that ophthalmological terminology varies from time to time and from one writer to another. For example, forty-six years ago Frost[1] applied the term "connective tissue ring" to the same ophthalmoscopic entity which Duke-Elder[2] recently described as a "scleral ring."

Before we begin our discussion of an ophthalmoscopic routine it may be profitable to survey briefly the literature in this field. The references cited in this article are all illustrated with colored drawings of the fundus oculi. There are three relatively recent black and white photographic works on the fundus oculi by Bedel, Wilmer and Bothman. There is also a photographic atlas in color by Dimmer and Pillat. An excellent series of articles by Bennett on ophthalmoscopy is appearing in the Optometric Weekly. A recent publication by the C. V. Mosby Company, "THE EYE MANIFESTATIONS OF INTERNAL DISEASES" by Dr. I. S. Tassman will also be of interest to the student of ophthalmoscopy. The works of earlier writers on ophthalmoscopy such as Jaeger, Mauthner, Schweigger, Schmidt-Rimpel, Elschnig, Axenfeld, Alt, Berry, Haab and Frost and the "ATLAS OF HISTOPATHOLOGY OF THE EYE" by Adelbert Fuchs are now out of print and difficult to obtain. The above references supplement those cited in this article and, having thus introduced the reader to the authorities on ophthalmoscopy, we now begin our consideration of an ophthalmoscopic routine.

In this routine we classify our observations under four subjects: Disc, Macula, Fundus and Vessels. The logical place to begin an ophthalmoscopic examination is with the disc. Here one observes the disc as a whole, noting the form, size, level, color and translucency. The next step is the observation of the three principal areas of the disc: Central, Intermediate and Peripheral. The following references are cited with the expectation only a few will be available to most readers.[3,4,5,6,7,8,9]

In the central area we observe first the color and then the level which may be elevated, on plane or depressed in a physiological cup. Next we note the size, shape, depth and direction of the cup and whether or not the lamina cribrosa is visible. One may infrequently observe a "porus opticus."

In the intermediate area of the disc the most important point to observe is the color. Any abnormalities that are present should be located with reference to the distribution of the fibres. For example, one may

observe that the area of the disc involving the superior macular fibres is very pale or the sector of the peripheral nasal fibres is covered by remnants of a hyaloid membrane.

In the peripheral area of the disc we note whether or not the margin of the papilla is distinct. Around the margin one may expect to find a complete or partial scleral, pigment, or choroidal ring, or crescent, or conus. A temporal conus may be either congenital or acquired in myopic conditions according to Adam.[10] Troncoso[11], on the other hand, believes that every temporal conus is congenital and colobomous in nature. In regard to the inferior crescent or conus both Adam[12] and Troncoso[13] consider it to be a rudimentary coloboma of the choroid.

The acquired or myopic conus may also be described as a "distraction crescent" according to Adam.[14] Two other types of crescents are described by Adam[15] under the names of "retraction crescent" and "supertraction crescent." The latter is also described by Oatman[16] in connection with progressive myopia. Around the papilla one may observe striated halos due to what appears to be translucent nerve fibres according to Johnson,[17] and Frost.[18]

The macula next claims our attention. Here we observe the density and color of the pigmentation, the foveal and macular reflexes. Johnson[19] describes three types of macular reflexes of which the reflection type is the most common. One may occasionally see a semi-transparent nerve fibre type of reflex but the choroidal type seems to be as rare as it is conspicuous.

The third major division in our routine deals with the fundus. The type of fundus we will find will be determined in part by the individual. The negroid[20,21] brunette or southern European[22], and the nordic or blond type[23], of fundi are all illustrated in ophthalmological works. In general, one will find the types of fundi divided into three classifications by most ophthalmological writers[24,25]. The first type is the "Uniform Stippled," the second is the "Tesselated" or the "Tigroid" and the third is the "Albinotic" type.[26,27,28]

One may find in ophthalmological literature three different variations of the tesselated type of fundus. The type of tesselation described by Adam[29] may be considered as a normal tesselated fundus in which the choroidal vessels and dark intervascular pigment are visible. Then there is what may be described as an abnormal type in which the choroidal intervascular pigment is predominant. Haab[30] has a beautiful plate to illustrate this type of tesselation. The third variation of the tesselated

fundus is one in which the choroidal vessels and non-pigmented intervascular spaces are visible. This type has been described by Frost[31], and by Oatman[32] who has named this particular type of tesselation as "reticulated."

The fourth and last division in our routine deals with the vessels of the eye. We observe the vessels on the disc and note the number and level of bifurcation. The relation of vessels to cup or disc margins is noted most carefully. Do the vessels break and disappear to appear again at a lower level or do they just break over the edge? As the veins bend to descend into the physiological cup one may observe pulsation occasionally at or close to the point of bending downward. The presence or absence of perivascular lymph stasis is also noted.

Next we proceed to examine the vessels of the fundus. A complete examination should include following each vessel out to its termination. We first note the caliber of the vessels, relative difference in size between artery and vein and any variation in caliber such as contractions or dilations.

With respect to the color of the vessels we note the color of the blood stream and the color of the walls when visible which may appear as parallel silver stripes or as a white cord. The color and width of the reflex is noted and if there are any places where the reflex is not present. We observe the course of the vessels and observe whether or not there is a crossing phenomenon. The vessels may be straight and drawn out in a thin line or tortuous. Tortuosity may be present in two or three dimensions.

The consistent allotment of a minimum of three to five minutes for any routine of ophthalmoscopic examination will prove to be very profitable to both patient and examiner. An intimate acquaintance with the normal eye and its physiological variations greatly increases the capacity to recognize pathology.

In conclusion we quote Professor Haab[33] as follows, "The appearances of the normal eye-ground as seen with the ophthalmoscope present, as I have stated in the beginning, so many variations that a thorough knowledge of the normal conditions is of greatest importance before proceeding to a study of pathological alterations . . . I cannot too strongly advise the beginner to study normal eyes as often and as thoroughly as possible."

CLARENCE W. MORRIS.

REFERENCES

1. "Fundus Oculi" by W. Adams Frost, F.R.C.S., Macmillan and Company. 1896. Page 38-44 and Fig. 2.
2. "Text Book of Ophthalmology" by Sir W. Stewart Duke-Elder, C. V. Mosby Co., 1941 Vol. 1, page 107, Fig. 144.
3. "Text Book of Ophthalmology" by Duke-Elder, Vol. 1, 2 and 3.
4. "Fundus Oculi" by Frost.
5. "Internal Diseases of the Eye and Atlas of Ophthalmoscopy" by Manuel Uribe Troncoso, M.D., F. A. Davis and Co., 1940, Chapters III, IV, VII and VIII.
6. "Diagnostics of the Fundus Oculi" by Edward L. Oatman, M.D., The Southworth Co., 1913, Chapters II and III.
7. "A Pocket Atlas and Text Book of the Fundus Oculi" by G. Lindsay Johnson, M.A., B.C., M.D., Camb., F.R.C.S., Eng., Adlard and Sons, Ltd., London, 2nd Edition 1931, Chapters II, III and IV.
8. "Ophthalmoscopic Diagnosis" by Dr. C. Adams, Translated by Foster, Rebman Company, 1913.
9. "The Ophthalmoscope and How to Use It" by James Thorington, A.M., M.D., P. Blakiston's Son and Co., 1906, Chapters II, III and VII.
10. "Ophthalmoscopic Diagnosis" by Adam, Pages 34-39.
11. "Internal Diseases of the Eye and Atlas of Ophthalmoscopy" by Troncoso, Pages 130-132.
12. "Ophthalmoscopic Diagnosis" by Adam, Page 139.
13. "Internal Diseases of the Eye and Atlas of Ophthalmoscopy" by Troncoso, Pages 132-133.
14. "Ophthalmoscopic Diagnosis" by Adam, Pages 35 and 36.
15. *ibid.*
16. "Diagnostics of the Fundus Oculi" by Oatman, Pages 247-8, Fig. 158.
17. "A Pocket Atlas and Text Book of the Fundus Oculi" by Johnson, Fig. 3 and 4.
18. "Fundus Oculi" by Frost, Fig. 4 and 6.
19. "A Pocket Atlas and Text Book of the Fundus Oculi" by Johnson, Page 90.
20. *ibid,* Fig. 4
21. "Diagnostics of the Fundus Oculi" by Oatman. Stereogram 3.
22. "A Pocket Atlas and Text Book of the Fundus Oculi" by Johnson, Fig. 3.
23. *ibid,* Fig. 1.
24. "Ophthalmoscopic Diagnosis" by Adam, Pages 24-32, Fig. 1, 2, 3.
25. "Internal Diseases of the Eye and Atlas of Ophthalmoscopy" by Troncoso, Chapter III and Fig. 32.
26. "A Pocket Atlas and Text Book of the Fundus Oculi" by Johnson, Fig. 2.
27. "Diagnostics of the Fundus Oculi" by Oatman, Stereogram 15.
28. "Atlas and Epitome of Ophthalmoscopy and Ophthalmoscopic Diagnosis" by Prof. Dr. O. Haab, Edited by G. E. DeSchweinitz, A.M., D.M., W. B. Saunders and Company, 1901, Fig. 10B.
29. "Ophthalmoscopic Diagnosis" by Adam, Fig. 2.
30. "Atlas and Epitome of Ophthalmoscopy and Ophthalmoscopic Diagnosis" by Haab, Fig. 5B.
31. "Fundus Oculi" by Frost, Fig. 7.
32. "Diagnostics of the Fundus Oculi" by Oatman, Stereograms 2-19-56.
33. "Atlas and Epitome of Ophthalmoscopy and Ophthalmoscopic Diagnosis" by Haab, Page 67.

TRANSACTIONS OF THE AMERICAN ACADEMY OF OPTOMETRY

by J. Fred Andreae, Secretary

A department devoted to announcements, reports, appointments, organization data, news, professional problems and ideals, as these relate to the Academy.

AMERICAN OPTOMETRIC ASSOCIATION TO MEET IN DALLAS

The Annual Congress of the American Optometric Association will be held at the Adolphus Hotel, Dallas, Texas, June 21-24. The President, Dr. John E. Corbett of Boston, will preside. Dr. J. E. St. Clair of Mineral Wells, Texas, is the General Chairman of the Convention Committee, with Dr. S. K. Lesser of Fort Worth, in charge of the educational sessions. Despite the war, a large attendance of optometrists is expected. Delegates should make their hotel reservations at once.

REPORT OF THE COMMITTEE ON NOMENCLATURE AND STANDARDS

The Committee has not been able to function as a Committtee because the Chairman was unable to complete the accumulation of information which he felt should be placed in the hands of the members of the Committee before having the Committee take action as a group. The Chairman himself has spent considerable time in surveying the literature for the purpose of preparing a report of the development of research and nomenclature, relative to accommodation and convergence. It is recommended that this Committee be retained in office during the coming year.

Respectfully submitted,

Glenn A. Fry, Chairman.

BOOK NOTICES AND REVIEWS

Books received are acknowledged by notices in this department. Special selections will be made for more extensive review in the interest of our readers as space permits.

LECTURES DELIVERED AT THE 44th ANNUAL CONGRESS OF THE AMERICAN OPTOMETRIC ASSOCIATION. Published by the Journal of the American Optometric Association, 512 Wilmac Bldg., Minneapolis, Minn. 70 pages. Paper covers. $1. 1941.

This interesting and timely booklet consists of transcripts of the lectures given last summer at the Atlantic City Convention and comprises the following topics:

1. Forum on *Important Considerations in the Development of a Modern Reading Program* consisting of Opening Remarks, Dr. Earl H. Ridgeway; "The Study of Reading Needs", Dr. Emmett A. Betts; "Reading in the Elementary Schools", Thomas J. Durell; "The Physical Eye and the Mind's Eye", Dr. Ernest C. Witham; "A Program of Cooperation in Remedial Reading", Harry S. Hill; "The Comics—Their Appeal and Their Peril", Olive G. Williams; "The Significance of Eye Readiness in a Reading Readiness Program", Dr. Mildred G. Moss; "Visual Deficiencies as a Problem in Reading", Althea H. Nichols; Summary of Forum in Reading, Dr. Anna S. Starr.
2. "A Simple and Direct Clinical Method of Conditioning the Squinter to Normal Visual Habits", Dr. Frederick W. Brock.
3. Forum on *Vision in Defense Industry* consisting of Introduction, Dr. John R. Wittekind; "Conservation of Man-power in Defense Industry", Verne A. Zimmer; "Prevention of Eye Injuries in Industry", Harry Guilbert; "The Problem of Employing Eyes", A. A. Hendrix; "Better Eyesight—Stronger Defense", Samuel G. Hibben; "Industrial Lighting in the Light of Total Defense", H. L. Logan; "Light, Vision, and Seeing in Industry", Frank K. Moss.

The keynote of these lectures is well expressed by Ridgeway in his Opening Remarks when he states that "carefully planned programs of professional cooperation prompted this conference. It is hoped that conferences such as this will eventually develop a sphere of mutual understanding which will be truly national in scope. . . ." It would seem that such meetings as this should indeed provide a most favorable avenue through which further inter-professional cooperation may be achieved. One is also impressed by the emphasis upon the psychological approach to all of the topics.

Both Betts, in his address based upon his work as Director of the Reading Clinic of the Pennsylvania State College, and Brock in his treatise on squint, present this point of view. Betts discusses the need for differentiation of instruction in the schools and that "one should

know the child before attempting to teach him." This would appear to be sound advice for the practice of optometry as well as for teaching. He outlines a program for analysis, devoting considerable attention to case history and differentiation of services. Under the latter topic he mentions the need for a greater integration of research findings from other fields and closer inter-professional cooperation. In connection with preventive work the change in emphasis from mechanistic to functional concepts is stressed, that the act of vision is a psycho-physiological process, not a mechanistic one.

This point is also well brought out in Witham's lecture on the Physical Eye and the Mind's Eye, wherein as an educator, he states that it is the creation of a mental picture which constitutes reading. This, of course, is also true of all of our seeing. Practically all of the discussions included in the reading forum seem to convey the need for something more fundamental than an improvement in the physical factors alone. The child must be properly conditioned psychologically as well.

Interestingly enough, this is much the same thought which underlies Brock's admirable discussion of how to prepare the squinter for normal visual habits. He states very clearly from his experience as Director of the Squint-Research Department of the Columbia University School of Optometry that his technique involves, above all, becoming thoroughly acquainted with the squinter's point of view. He mentions the unfortunately high incidence of failure in the correction of most squint cases which do not achieve permanent normal binocular vision and suggests as a cause the usual neglect of properly conditioning the patient to his new visual experiences. This involves, among other things, the correction of false projection habits which tends to assume the form of monocular diplopia representing a purely mental attitude to be overcome by reasoning rather than by orthoptic exercises. He outlines his pre-instrumentation phase of treatment, which includes methods for obtaining true physiological diplopia and the achieving of a normal accommodation-convergence relationship. It is only at this point that the patient is considered properly conditioned for stereoscopic training which, in his opinion, should offer a fair chance of success.

In the Forum on Vision in Defense Industry several representatives from the field of business are included such as Guilbert, who as Director of the Bureau of Safety and Compensation of the Pullman Company, cites arresting figures on the cost of eye accidents which exceed $100,-

000,000 per year throughout the country. If, as he declares, 98% of such losses can be prevented, then the course should be clear for the institution of safety programs throughout the various fields of industry. He outlines an eye safety program which involves having all employees in a given plant wear protective goggles and he recommends the use of hardened lenses for this purpose. It would seem that such a project would be one in which the safety engineer and the optometrist could well cooperate.

On the whole, this section of the book is not of quite the interest to optometrists as the preceding portion although, even here, the point is made abundantly clear that this problem of better seeing requires the collaboration of specialists from many otherwise diverse fields.

ARTHUR B. EMMES.

THE SYNTONIC PRINCIPLE. ITS RELATION TO HEALTH AND OCULAR PROBLEMS. Harry Riley Spitler, D.O.S., M.D., M.S., Ph.D. 210 pages. Illustrated. College of Syntonic Optometry, Eaton, Ohio. $10.00. 1941.

In his book Spitler contrives to cover the field of ocular function, and succeeds in a remarkable degree albeit briefly. It was first written as a thesis for his Ph.D degree; some material has been deleted, some has been added, in order to bring it up-to-date and make a readable book.

One theory listed among others by Spitler, is that the electric potential at the synapse, is affected by the retinal perivascular lymph spaces and is one of the major factors involved in the transference of impulses between the dendrite. This is borne out by Evans' book on *Clinical Scotometry* which this reviewer used as a basis in eliminating syntonically the wedge shaped scotomas for ½° colors on the campimeter and enlarging the entire field of vision on the perimeter (1° stimuli), as reported last year in a paper, on a series of 439 charts on 17 patients.

Spitler is concerned with the effect of selected frequencies of the visible spectrum on the retina, from a theoretrical and clinical aspect, quoting many references on the experimental data which he has accumulated, and eventually he cites a tabulated group of 3,067 clinical patients.

He presents a condensed resume of the subject, citing other authorities where they have done research, which those who practice syntonics

will do well to read in order to learn how much more of the field there is than what they already know; those who have practiced it to some extent without achieving the results they hoped for can learn how their lack of adequate background of case history, lack of knowledge of the human physiology and neurology involved, and lack of adequate study of the effect of the specific frequencies on the visual system may be rectified and thereby enable them to achieve results more easily, quickly, and definitely; those who have never studied the principles of syntonics now have an opportunity to learn just what this method is all about.

Study is essential in anything dealing with the human body, and those who enter this particular branch of ocular work should certainly have as a background all that Spitler can tell from his experiences. The act of turning a filter into place does not constitute a guarantee that results will be obtained; it is as important to learn why results were not achieved as it is to know how they were engendered. Here Spitler has presented much which may be of value. S. HERMAN SHURIN.

NURSING IN DISEASES OF THE EYE, EAR, NOSE AND THROAT. D. H. Webster, M.D.; J. R. Page, M.D.; F. W. White, M.D.; R. E. Buckley, M.D.; D. S. Cunning, M.D.; A. G. Langmann, M.D.; A. A. Eggston, M.D., and Hazel Emmett, R.N. 7th Edition. Published by the W. B. Saunders Company, West Washington Square, Philadelphia, Penna. Illustrated. 313 pages. Cloth. 1942. $2.50.

Members of the staff of the Manhattan Eye, Ear and Throat Hospital have collaborated in the revision of the 7th edition of this text dealing with the duty of the nurse as an assistant to the physician and surgeon in dealing with problems of treatment and surgical care of the head and neck. Eighty-four pages are devoted to eye care. This section is well written and easily understood and while outside the scope of optometric care may be of interest to some optometrists.

CAREL C. KOCH.

ABSTRACTS

A department in which will appear abstracts of the literature of optometry, ophthalmology and applied optics. These will be classified according to the following list, although contributions to all sections will not necessarily appear in each issue.

1. Ocular Refraction.
2. Physiological Optics and Color Vision.
3. Ocular Muscles.
4. Orthoptics and Reading.
5. Anatomy, Histology and Embryology.
6. Ocular and General Pathology.
7. Ophthalmic Lenses and Material.
8. Instruments.
9. Hygiene and Illumination.
10. Applied and Physical Optics.
11. Education, Sociology and Economics.
12. Miscellaneous.

1. OCULAR REFRACTION

THE CLINICAL APPLICATION OF KERATOMETER MEASUREMENTS. Petry, E. Optometric Weekly. 1941, 32, 41, 1157-1160.

Petry discusses certain phases of correcting astigmatism and the value of the keratometer (ophthalmometer) findings in prescribing for near-point visual problems. It is his belief that when the gross keratometer findings in either plus cylinders, or minus cylinders and plus spheres, are placed before the patient's eyes, preliminary to the near-point dynamic skiascopic examination, a maximum inhibiting of the habitual astigmatic compensating act will be induced on behalf of the ciliary muscle.—C. C. K.

SOME NOTES ON THE TREATMENT OF MYOPIA BY CALCIUM. Cole, J. Refractionist (London). 1941, 30, 525, 212.

Cole believes that the ingestion of calcium in combination with the inclusion of the base-in prisms in ocular corrections retards or arrests progression in some cases of adolescent myopia. Several cases are mentioned.—C. C. K.

MYOPIA AND CONTACT LENSES. Feinbloom, W. Optometric Weekly, 1941, 31, 48, 1354-1355.

The use of contact lenses in cases of high myopia has several advantages, according to Feinbloom, who claims that the patient has a wider field of vision and less distortion, in using these aids to sub-normal vision, than when using the myopic correction made up in the usual ophthalmic lenses. Two case reports are presented.—C. C. K.

2. PHYSIOLOGICAL OPTICS AND COLOR VISION.

MONOCULAR DIPLOPIA OCCURRING IN CASES OF SQUINT. Cass, E. E. British Journal of Ophthalmology, 1941, 25 (December), 565-577.

Monocular diplopia which is sometimes complained of and at other times can be evoked artificially, is found in cases of squint which have no physical defect in the lenses, corneae, pupils, retina, etc., to account for this phenomenon, but have some abnormal retinal correspondence. Such a case was first reported by Javal in 1864. Of the 70 cases studied by Cass, 33 obtained monocular diplopia. The explanation of the phenomenon lies in the consideration of the congenital space value of retinal points as conceived by Hering and the formation of an abnormal retinal correspondence. In this condition, where both a false and a true correspondence are present, each retinal point must possess two space values, i.e., a congential and an acquired and one retinal point can orientate itself in two entirely different positions in space with no movement of the eyes having taken place. It is the consciousness of both space values simultaneously which produces the monocular diplopia. Methods of eliciting the phenomenon are described.—R. J. B.

---

4. ORTHOPTICS AND READING.

UNUSUAL CASES. Gibson H. W. Optician (London). 1941, 102, 2646, 250.

Gibson presents three cases from the orthoptic clinic of the London Refraction Hospital. Refractive corrections, prism therapy and orthoptics all played a part in the improvement shown by these patients.

Case 1. Male. Age 19. The patient complained of headaches and also that the right eye closed when reading. The patient had a history of a head injury some ten years before and the external examination disclosed a scar at the right inner canthus. The patient was found to be slightly hyperopic, accepting O.D. +0.75 D. Sph., O.S. +0.50 D. Sph. Visual acuity, both corrected and uncorrected, was normal. In testing the extra-ocular muscles the patient was found to have, in the primary position, 4△ of exophoria, and 3½△ of right hyperphoria. An examination of the versions indicated a paresis of the right superior oblique muscle. The case was considered unsuitable for orthoptic treatment and

the following correction was prescribed for constant wear along with "pencil-to-nose exercise," for daily use at home. O.D. +0.75 D. Sph. ⊂ 1½△ base-down. O.S. + 0.75 D. Sph. ⊂ 1½△ base-up. The patient reported two months later that he was comfortable and the right lid had stopped drooping, during periods of reading.

Case 2. Male. Age 13. The patient complained of blinking and photophobia. Symptoms were present during most of the past seven years although patient had used a correction during this entire period. His present correction proved to be, O.D. +0.50 D. Cyl. axis 90. O.S. + 0.25 D. Sph. ⊂ +0.75 D. Cyl. axis 80. The patient's visual acuity was normal, both uncorrected and corrected. An examination indicated no need for a change of his correction. In testing the extra-ocular muscles the patient was found to have orthophoria for distance; 6△ of exophoria at near. He had a near point of convergence of 15 cm.; while his adduction was at distance 4△, and at near 8△. Orthoptic treatments were prescribed. These consisted of adduction exercises on the Pigeon-Cantonnet sterescope and "pencil-to-nose"exercises. His mother was instructed to supervise the orthoptics at home. A month later he reported that the excessive blinking had disappeared and that he was perfectly comfortable. His near point of convergence was 6 cm.; and his distance adduction was 20△ while his near adduction was 40△.

Case 3. Male. Age 19. The patient reported that he had tried to join the Air Force and had been rejected because of his poor visual acuity in the left eye. An examination revealed that this eye was amblyopic. The findings were as follows: O.D. —0.50 D. Cyl. axis 180, Visual Acuity = 20/20. O.S. —1.50 D. Sph. ⊂ —2.00 D. Cyl. axis 90, Visual Acuity = 20/50. The uncorrected visual acuity was O.D. 20/40. O. S. 20/120. Orthoptic training on the optophore was given at the clinic. In addition home exercises were prescribed, the patient to use the Pigeon-Cantonnet sterescope as a Maddox Cheiroscope for tracing. The right eye was occluded for three hours daily. Special attention was given to various forcing exercises and a flashing technique was also used. These treatments continued for two months. The patient was then re-examined. The uncorrected visual acuity of the left eye had improved to 20/50, and with the following correction the patient had a distance visual acuity of 20/20. O.S. —1.00 D. Sph. ⊂ —2.00 D. Cyl. axis 90.

—T. O. B.

BINOCULAR VISION. Lange, C. W., Sr., and Lange, C. W., Jr. Optometric Weekly. 1941, 32, 34, 961-963.

The authors point out that many patients who suffer from visual or ocular symptoms do not require glasses but may be given relief by stereoscopic orthoptic treatments of the fusion faculties to establish better binocular coordination.—C. C. K.

BASIC VISUAL TRAINING. Steinfeld, A. Kentucky Optometrist. 1941, 15, 10, 4-8.

Steinfeld believes that 40 per cent of our patients need visual rehabilitation through the medium of various orthoptic techniques. Two-thirds of this group have ocular symptoms while the remainder are visually inefficient. All non-pathologic refractive cases are divided into three groups, (1) cases in which lenses only are needed, (2) cases in which only training or orthoptics are needed, and (3) cases in which both lenses and orthoptics are needed. The orthoptic treatments are first given monocularly. These consist of stimulations in the field of rotations, fixations and accommodative responses. When these monocular responses have reached a point of normal for the case being treated, the orthoptic procedures are repeated, the stimulations being given binocularly. The orthoptic treatment techniques are presented in some detail.—C. C. K.

ORTHOPTICS: CLINICAL EVALUATION OF RECENT ADVANCES. Wheeler, M. C. Archives of Ophthalmology. 1941 (August), 26, 260-264.

"Written reports of results of orthoptic treatment are provocative but far from convincing in the majority of instances. The great variation in the classification of cases; the lack of concise definitions of terms and methods, and the complete absence of unanimity as to criteria for cure are among the factors that make confusion inevitable." It is felt, however, that orthoptic training is on a much firmer footing than it was a few years ago, and that it gives valuable information about binocular function, which with further experience should prove a guide in the operative treatment. Research clinics should be encouraged to continue in as many institutions as possible.—R. J. B.

PITFALLS IN ORTHOPTIC TRAINING OF SQUINTS. Brock, F. W. Optometric Weekly. 1941, 32, 42, 1185-1189.

The author finds that the three major pitfalls in the orthoptic treatment of alternating squint are (1) that the patient treats all visual impressions of the squinting eye which are consciously retained, as if they were virtual, or in other words as if they were seen through a mirror. (2) The patient has a persistent aversion to fusion, and (3) as the treatments proceed normal binocular vision and anomalous binocular vision may alternate according to the patient's needs or wishes. Brock discusses various methods of overcoming these difficulties.—C. C. K.

THE SAN FRANCISCO ORTHOPTIC LABORATORY: A CO-OPERATIVE ESTABLISHMENT. Cordes, F. C. American Journal of Ophthalmology. 1941 (September), 24, 1057-1060.

This laboratory was organized by a group of ophthalmologists and is conducted by a trained technician who holds the certificate of the American Orthoptic Council. The equipment (which is listed), together with the necessary furnishings, represents a total expenditure of approximately $1,500.00. The stock of the laboratory was divided into 14 units, each of which guaranteed $25.00 a month support for the trial period of one year. The laboratory started operation in January, 1939, and since the first three months has been self-supporting. The average monthly expense over a period of 18 months has been $307.16. The average fee for orthoptic treatments has been $2.50 with a fee of $20.00 for a course of 12. The details of organization and use are discussed. Possibilities of expansion for use as a center for fundus photography, aniseikonic tests, field studies, and reading problems are indicated. "The results have been excellent and have far surpassed those obtained under former methods." Mention is made of a similar laboratory at Vancouver and of the recent establishment of the Florence C. Noble Orthoptic Clinic at the University of California Medical School.—R. J. B.

Current Comments by Carel C. Koch

A Monthly Department

in which the Editor of the AMERICAN JOURNAL OF OPTOMETRY & ARCHIVES OF THE AMERICAN ACADEMY OF OPTOMETRY will discuss items of news of general interest: such as relate to new instruments, clinical techniques, education, public health, and optometric legislative and organization problems.

REMINISCENCES AS THE RESULT OF READING THE BOOK "OPTOMETRIC PROCEDURE"

A reading of the new book *Optometric Procedure* by Ryer and Hotaling[8], brings to mind some of the earlier classics which did so much to guide the feet of those of us who practiced optometry professionally some twenty or more years ago. It recalls, for instance, a book published under the title, *The Successful Optometrist*[3]. A little volume written anonymously in 1923, and given wide distribution at that time by one of the important instrument makers of that day. These two books cover much the same ground, although the new Ryer and Hotaling volume is so written as to present its material in greater detail than the book published nearly two decades ago.

Yet, with both books now before me, there seems to be a slight resemblance here and there which makes me wonder if the present authors of *Optometric Procedure* were not the anonymous contributors who gave us the equally useful book, *The Successful Optometrist?* But that is not really important. What is of importance is that these things have been written—and read, and that the fine suggestions made both then and now again, have been and will be followed by more and more optometrists.

The book *Optometric Procedure* also brings to mind the fact that it is now more than 20 years since Wiseman[2] electrified optometry with the publication of his professional classic *Building Optometry*. And also more than 20 years since Woll[1] gave to optometry his outstanding companion volume, *Hygiene the Optometrist Ought to Know*. Both of these books (published in 1921) were written during 1920, a really outstanding year for optometry, because it was during that year, in addition to the writings of Wiseman and Woll, that Charles Sheard started publishing the AMERICAN JOURNAL OF PHYSIOLOGICAL OPTICS.

While it is true that optometry had decided professional tendencies prior to 1920, and that prior to that date much fine work had been done by a number of men to professionalize the practice of refraction, it was nevertheless the impetus given in that direction during the years 1920-

1921 by Wiseman, Woll and Sheard in their writings and personal appearances that made inevitable the acceptance of the present day professional practices in optometry.

This new book by Ryer and Hotaling also calls to mind other of their own efforts in developing sound practice procedures as carried forward by them and their colleagues through the medium of ARCHIVES OF OPTOMETRY which they so ably edited during the several years of its existence. The early efforts of these optometrists and educators make possible the progress we enjoy today. These men and others like them were the pioneers who carved a professional niche for optometry which will ever remain as a tribute to their foresight and leadership.

Looking over the Table of Contents of *Optometric Procedure* brings to mind also some of the more recent contributions written in a more or less similar vein. One thinks of Brucker's[6] *Story of Optometry,* and Pine's[7] *Patient Control,* both of which emphasize the need for and the advantages of professional practice. One is also reminded of that excellent chapter on optometry in Klinefelter's[5] *Medical Occupations.* A chapter which never could have been written were it not for the groundwork so well laid years before by those just mentioned.

The proper emphasis placed on sound professional procedures by Ryer and Hotaling also calls to mind the Academy Report, *Ophthalmic Services in a Changing World,* by Jaeckle[4] in which is shown the newer trends of practice in all professional fields. Trends bringing irresistible changes which are rapidly overtaking those optometrists whose natural inclination seems to be the pursuit of commercial optometric practice.

In the past two decades much that is good has been accomplished. Optometry is gaining in professional stature from month to month. Thanks to constantly improved under-graduate training and better graduate study the ocular work we are doing improves apace. However more work remains to be done. And we for one are grateful for that far-sighted band of leaders, of whom Ryer and Hotaling are a part, that this good work is carried on with an ever increased vigor.

CAREL C. KOCH.

REFERENCES

1. Woll, Frederic A. Hygiene the Optometrist Ought to Know. Published by the Author. New York City. 1921.

2. Wiseman, Eugene G. Building Optometry. Keystone Publishing Company. Philadelphia, Penna. 1921.
3. The Successful Optometrist. Published by the General Optical Company. Mount Vernon, N. Y. 1923.
4. Jaeckle, C. E. Ophthalmic Services in a Changing World. Report of the Committee on Socio-Economics. Published by the American Academy of Optometry. 1935.
5. Klinefelter, L. M. Medical Occupations. E. P. Dutton & Company, Inc. New York City. 1938.
6. Brucker, W. M. The Story of Optometry. Published by the Journal of the American Optometric Association. Minneapolis, Minn. 1939.
7. Pine, Harry E. Patient Control. Professional Press. Chicago, Ill. 1939.
8. Ryer, E. LeRoy, and Hotaling, Elmer E. Optometric Procedure. Published by the American Optical Company. Southbridge, Mass. 1941.

Therminon
REG. U. S. PAT. OFF.
COMFORT AND PROTECTION

Serve to Win!

War-time demands increased efficiency behind the lines as well as on the battle-fronts. Give your patients the comfort and protection of Therminon Lenses . . . formulated to block out 50% of the irritating infra-red radiations while transmitting 92% of the useful visible light. Help them "Serve to win!"

Therminon Lenses are distributed by leading independent jobbers, coast to coast. Ask your supply house representative for a demonstration of all ophthalmic lenses with Thermolux.

THERMINON LENS CORPORATION
DES MOINES, IOWA

JEFFERY OPTICAL COMPANY
JEFFERY COMPLETE Rx SERVICE
Wholesalers and Manufacturers

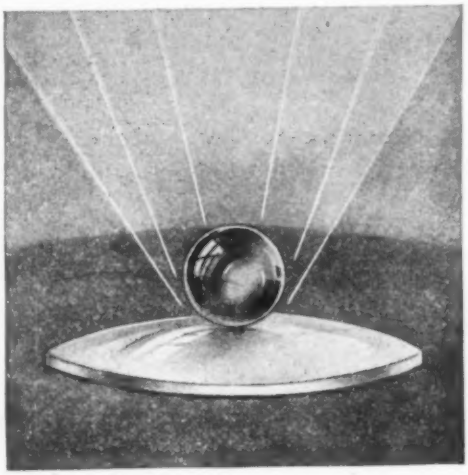
Physicians & Surgeons Bldg.
MINNEAPOLIS, MINN.

Atlantic 2469

Out of Town Rx's Returned the same day they are Received

First Quality Merchandise

A Friendly Accurate Service



Resists breakage

Benson Fortified Ophthalmic Lenses

HARDRx Prescription lenses are for general use and are tempered for increased margin of safety against breakage.

BENSAFE Prescription Safety lenses are of heavier construction and toughened for industrial and hazardous sportswear.

Both are of highest quality and are toughened by a controlled heat treatment. Each HardRx lens is subjected to impact of 1/2" steel ball dropped one meter and Bensafe lens to 3/4" steel ball dropped one meter.

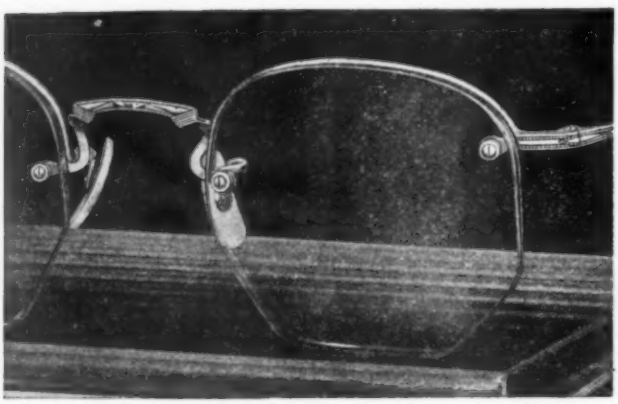
Drop Ball Test for controlled strength

N. P. BENSON OPTICAL CO. Inc.

Established 1913

Main Office: MINNEAPOLIS

Aberdeen - Bismarck - Duluth - La Crosse - Stevens Point - Eau Claire - Wausau - Albert Lea - Winona - Rapid City



GRACEFUL is the word for CUSHION - MOUNT in the popular rimway vogue. Superb construction by the makers of Cushion-Lock mountings.
Lenses are strain - free, breakage-free, wobble-free.

New

The Carlton CUSHION - MOUNT

Improved rimway construction . . . 2-point support maintains lens alignment . . . Backstraps have extra threads to hold screws . . . No metal touches glass . . . Enduring Duratex cushions protect lenses, lock screws . . . Duratex-lined washers insulate lenses from screw-heads . . . Carlton bridge in 10K gold . . . Truflo streamlined temples . . . License-free . . . ASK TO SEE CUSHION-MOUNT.

MINNESOTA OPTICAL COMPANY

MINNESOTA OPTICAL COMPANY

2928 Lyndale Ave. So. -:- MINNEAPOLIS, MINN.

The Difference Between

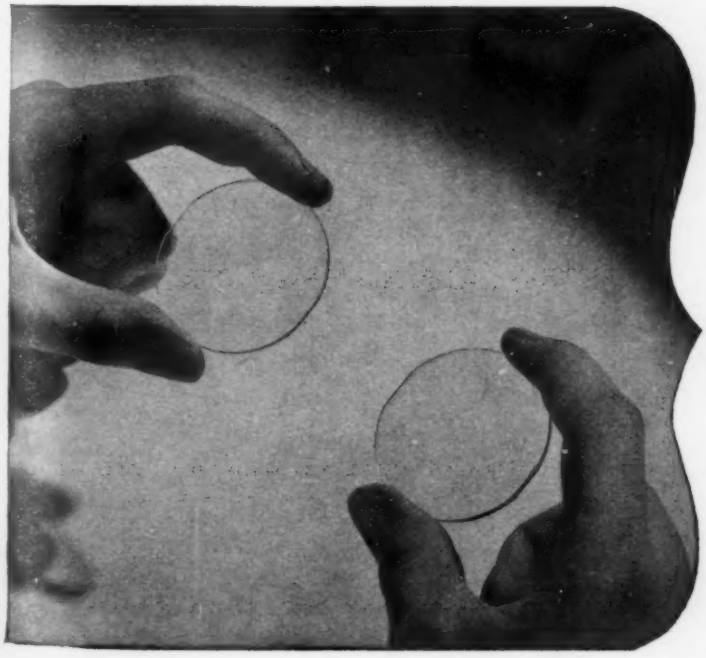
... passive satisfaction — and recommendation of your services to friends

... complete comfort — and "I guess they're all right".

... pride of possession—and just another pair of glasses.

is Soft-Lite Lenses

... because only Soft-Lite gives Soft-Lite performance



You can depend upon Soft-Lite Lenses. Made by Bausch & Lomb, their performance is always consistently fine. Always consistently dependable. Soft-Lite Lenses are true non-selective filters, reducing the quantity of light without affecting light quality. When absorptive lenses are indicated you will find it to your success to standardize on Soft-Lite.

EYES AND EFFICIENCY
Accurate vision without eyestrain is of front-line importance. If workers' eyes are below par, war work will be also. When glasses are needed, best performance comes from Shuron Shurset Ful-Vue glasses of QUALITY BEYOND QUESTION.
QUALITY BEYOND QUESTION

This Shuron Ad MEANS BUSINESS!

Timely and Pertinent, This Ad Will Bring Many New Patients Your Way

Time . . . . May 4
Collier's May 30
American Magazine May

← **WATCH FOR THESE ISSUES**

This latest Shuron advertisement, appearing in three of the most popular national magazines, is tuned to the times and will be read by hundreds of people right in your own locality. Take advantage of it—be prepared to meet the requirements of these prospective patients with SHURSET FUL-VUE mountings and WIDESITE WIDE ANGLE lenses—the ideal combination. Order now from your independent distributor.

QUALITY BEYOND QUESTION SINCE 1864

SHURON OPTICAL CO., Inc., Geneva, N. Y.